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Pilotless Bomber

SEPTEMBER-OCTOBER 1954

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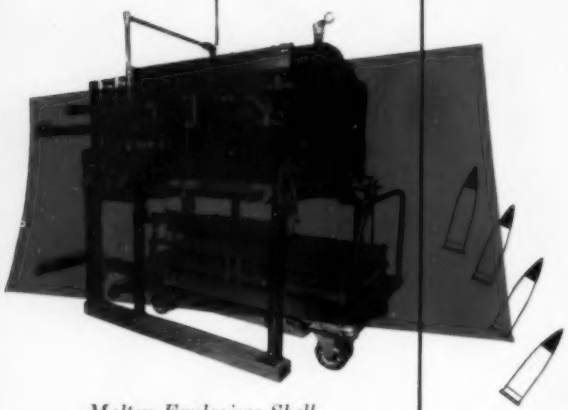

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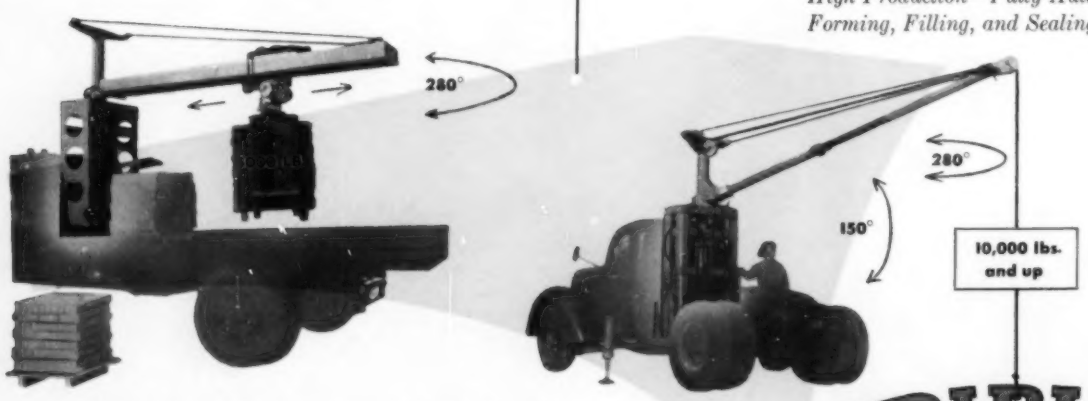

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ORDNANCE

LAND · SEA · AIR

The Magazine of Scientific and Industrial Preparedness

VOL. XXXIX SEPTEMBER-OCTOBER 1954 NO. 206

The Cover.—*The Air Force's B-61 pilotless bomber, the Matador, is an aircraft-type ground-to-ground guided missile. Easily shipped and assembled, the Matador is launched from a small, highly mobile launcher aided by a booster rocket which soon drops off, the bomber's turbojet engine propelling the weapon toward its target at the speed of a jet fighter.*

Editor: Leo A. Codd. *Managing Editor:* R. E. Lewis. *Editorial Staff:* M. L. Van Horn, R. K. Smith.

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GUIDE WORDS FOR TODAY–

"I believe

that we should battle the principles of communism and socialism and convince the world that its true happiness lies in the establishment of a system of liberty; that communism and socialism are the very antithesis of liberalism, and that only a nation conceived in liberty can hope to bring real happiness to its people or the world."

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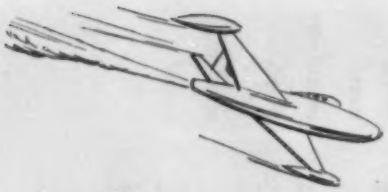

The 3 frontiers of know-how...

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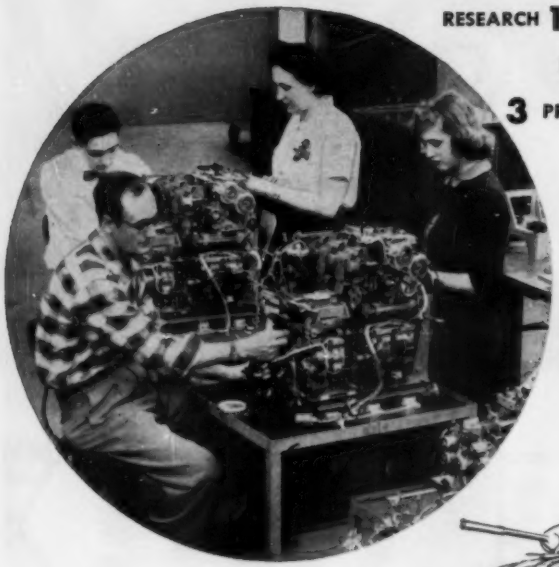
DEVELOPMENT 2

3 PRODUCTION



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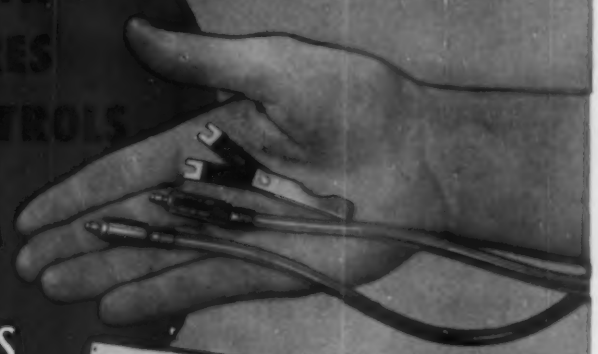

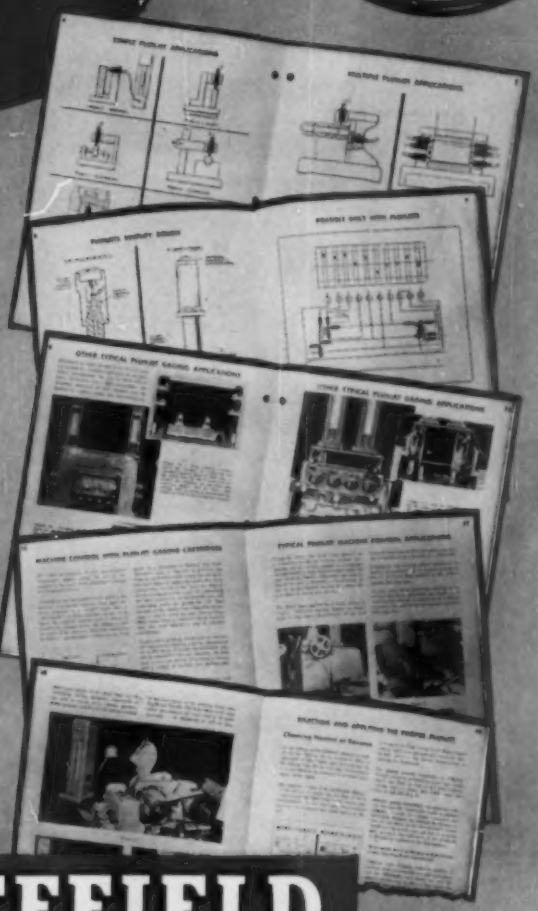

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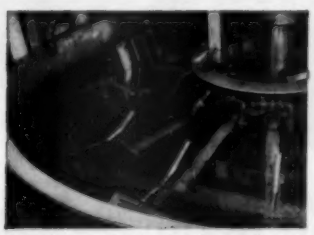

One of many G.P.&F. tests for quality and performance. Ammunition boxes are filled with air under pressure and submerged under water in a special testing machine.

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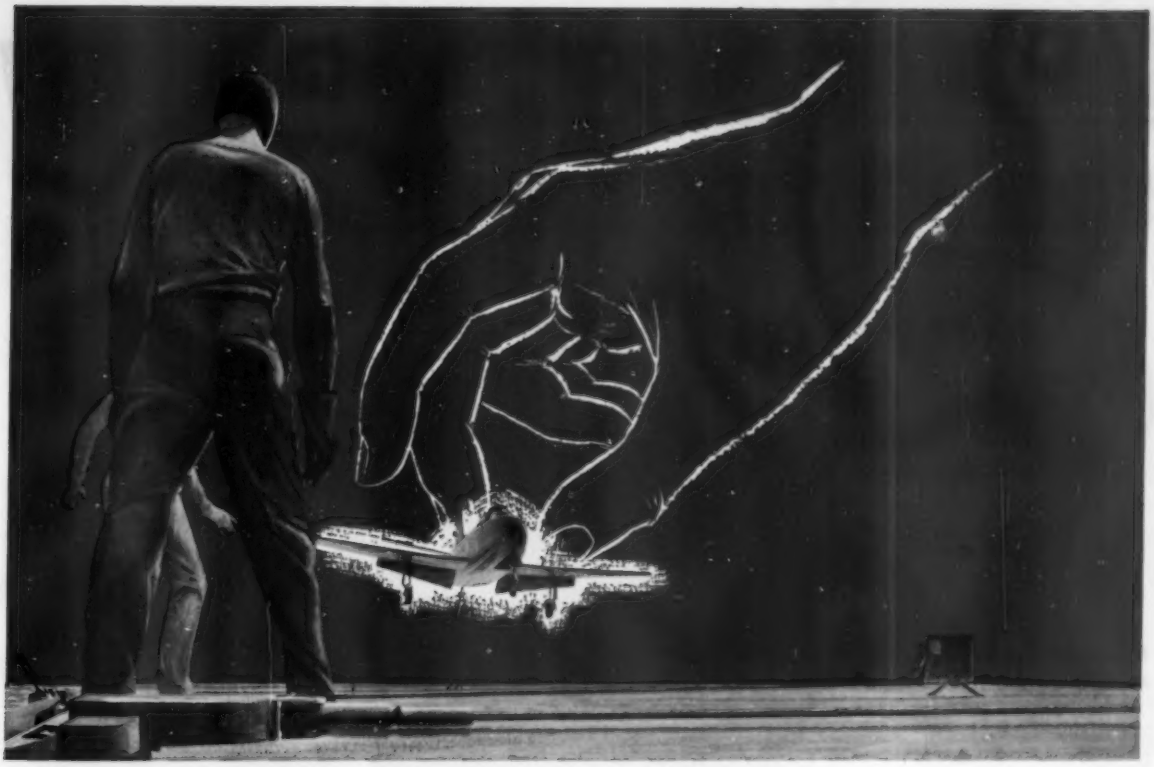

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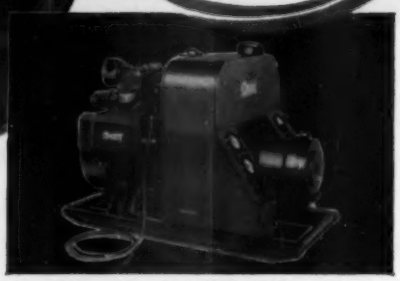

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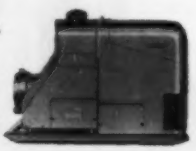

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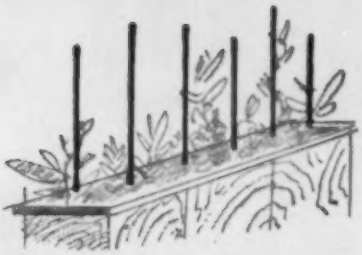
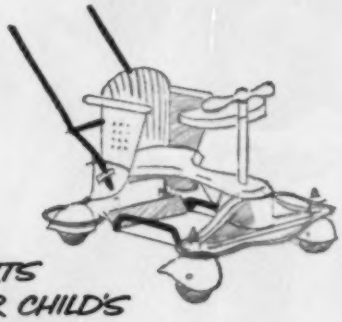


MODERN ROOM DIVIDERS



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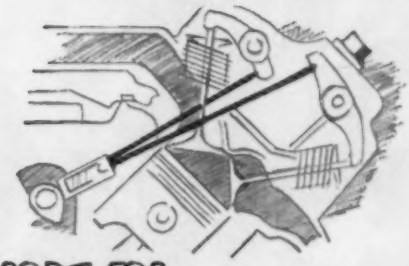

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Yesterday . . .
"The Fates" Decided
In the 6th century, B. C., King Croesus of Lydia was told by the Delphic Oracles he could defeat the Persians. Relying on "The Fates" instead of the facts, he took on an enemy he should have known was too strong for him . . . and he was badly beaten. Lack of facts cost him his kingdom and his freedom.

Croesus' cavalry stampeding at the sight of Persian camels

Today . . . Facts Are What Count

The recent great strides in military science, pure science, commerce, and industry have resulted from modern man's ability to determine the facts and act accordingly.

Tremendous advances have been made in the past few years in fact-finding machines. Through electronics, great masses of data that would have taken a lifetime to process can now be handled in a few days. Ordinary volumes of work can be done in minutes.

IBM
TRADE MARK

By making "mathematical models" of specific processes, products, or situations, man today can predetermine probable results, minimize risks and costs.

World's Leading Producer of Electronic Accounting Machines

INTERNATIONAL BUSINESS MACHINES, 590 Madison Ave., N. Y. 22, N. Y.

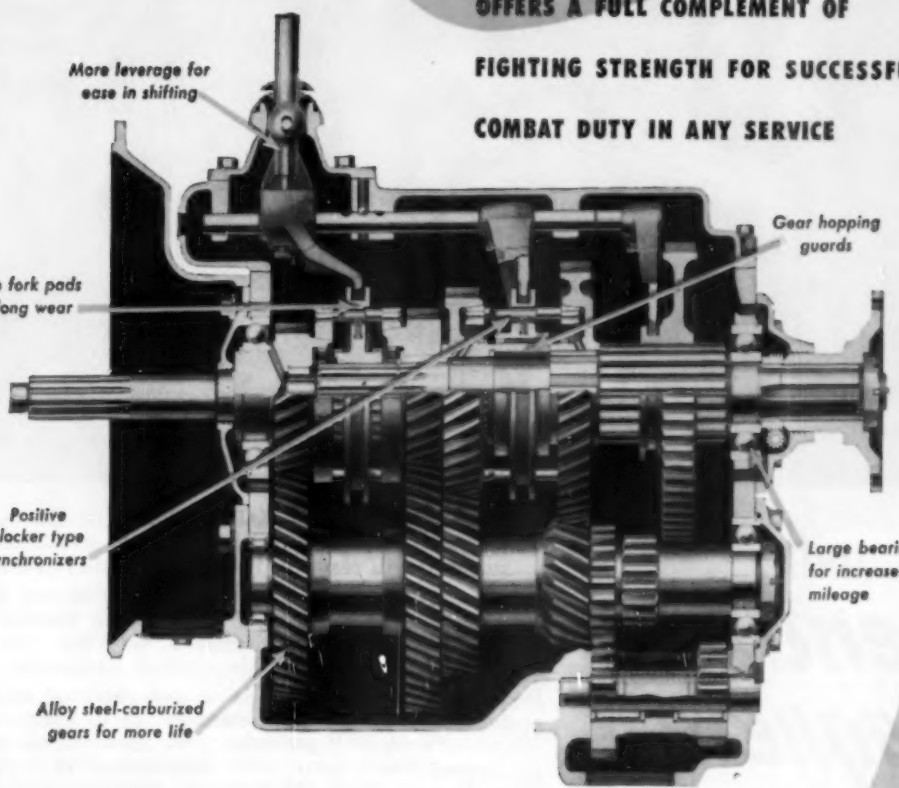
Spicer

SPECIALISTS IN SERVICE

Equal shifts for driver convenience

The Spicer Brown-Lipe Fully-Synchronized Transmission

OFFERS A FULL COMPLEMENT OF FIGHTING STRENGTH FOR SUCCESSFUL COMBAT DUTY IN ANY SERVICE

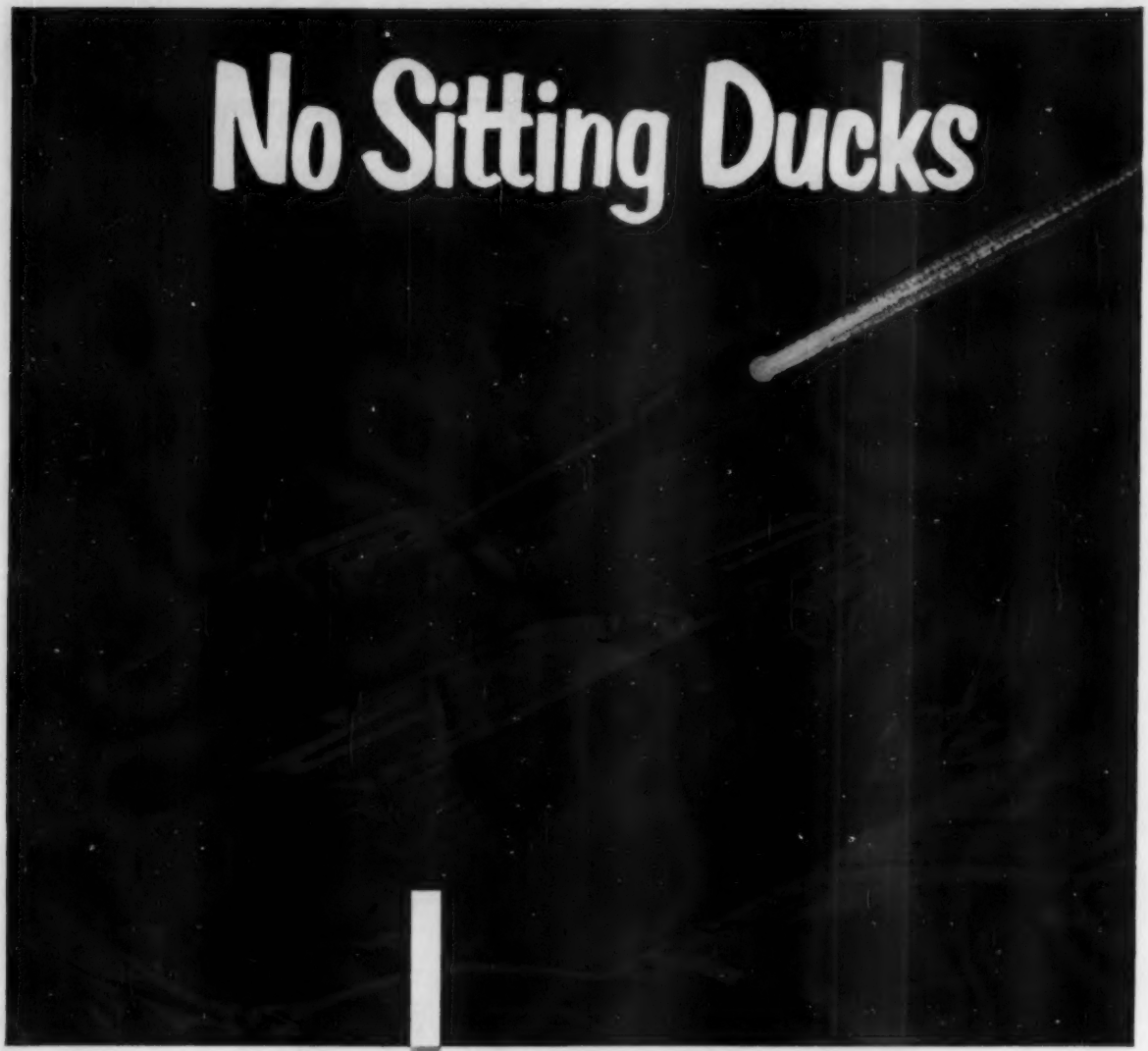

More leverage for ease in shifting
Gear hopping guards
Tocco fork pads for long wear
Positive blocker type synchronizers
Large bearings for increased mileage
Alloy steel-carburized gears for more life

48 YEARS OF Spicer SERVICE

SPICER MANUFACTURING

Division of Dana Corporation • TOLEDO 1, OHIO

TRANSMISSIONS • UNIVERSAL JOINTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • PASSENGER CAR AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES



with Bendix Magneto Ignition

Ignition failure on the field of battle would be a tragic matter. Every step should be taken to avoid any type of failure that will result in loss of lives and materiel.

Fortunately, in the case of ignition, a strong preventive measure has been taken. By specifying Bendix Magneto Ignition for tanks and armored vehicles, you are now getting the most dependable ignition available.

Bendix Magneto Ignition is an independent, self-sufficient system that places no demands on a normally loaded electrical system. It provides a hot spark at all speeds and minimizes fire hazard with elimination of supply leads. With Bendix Magneto Ignition, contact points and distributor electrodes have longer life because of inherent current reversal, and ignition is radio-shielded and waterproofed. Service is easier due to compactness and simplicity.

There are no "sitting ducks" due to ignition failure when you specify Bendix Magneto Ignition. Descriptive literature available on request.

Bendix

SCINTILLA MAGNETO DIVISION OF SIDNEY, NEW YORK

Bendix AVIATION CORPORATION

FACTORY BRANCH OFFICES:

117 E. Providencia Avenue, Burbank, California • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan

Brouwer Building, 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 582 Market Street, San Francisco 4, California

THESE two important Pittsburgh developments help speed production in the manufacture of any number of products demanding efficient sealing.

WELDSEAL TAPE protects spotwelded and hot-riveted assemblies from corrosion by sealing seams against moisture. When used between members prior to welding or riveting, it forms a tight gasket along the entire length of the seam, particularly around the shank of the spot or rivet. It will not burn away, but flows around the super-heated areas and returns to its original character at normal temperature.

Nu-CHROMSEAL TAPE is a solid, pliable compound in a film of fixed thickness for sealing lap joints or butt seams in metal, wood or fiber where rivets, bolts or screws are used. It weatherproofs roof and side panels of motor buses, caulks fender-to-body seams of motorcars and seams of marine craft. It seals water, gasoline or oil storage compartments. It insulates dissimilar metals to prevent corrosion. It stops squeaking and chafing where wood or metal parts rub against each other.

Samples of these tapes are available for experimental work. The services of our engineers also are at your disposal for consultation without cost or obligation to you. Write for free booklets containing information about the many uses of these remarkable industrial tapes.

PITTSBURGH PLATE GLASS CO. Factories: Milwaukee, Wis.; Newark, N.J.; Springdale, Pa.; Atlanta, Ga.; Houston, Texas; Torrance, Calif.; Portland, Ore. Ditzler Color Div., Detroit, Michigan. Thresher Paint & Varnish Division, Dayton, Ohio. Forbes Finishes Division, Cleveland, Ohio. M. B. Suydam Division, Pittsburgh, Pa.

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PITTSBURGH PLATE GLASS COMPANY

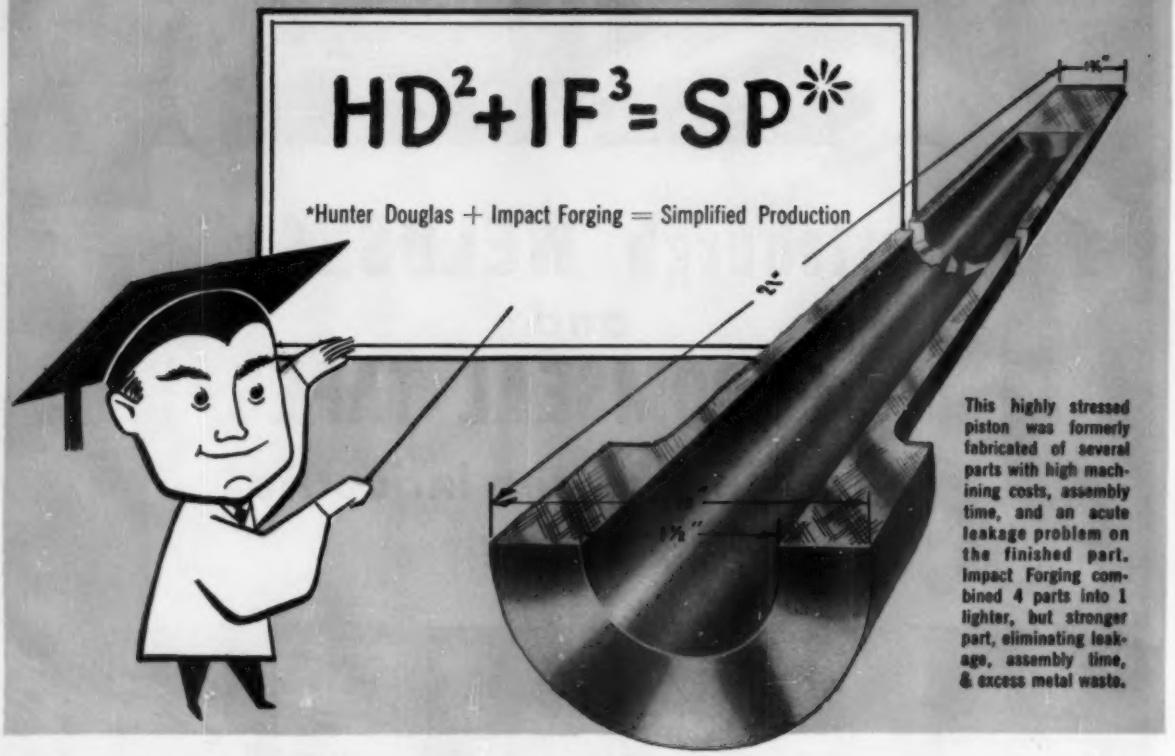
IN CANADA: CANADIAN PITTSBURGH INDUSTRIES LIMITED

Mr. Design Supervisor

...an equation you should know

$$HD^2+IF^3=SP^*$$

*Hunter Douglas + Impact Forging = Simplified Production



This highly stressed piston was formerly fabricated of several parts with high machining costs, assembly time, and an acute leakage problem on the finished part. Impact Forging combined 4 parts into 1 lighter, but stronger part, eliminating leakage, assembly time, & excess metal waste.

You can simplify design with...

IMPACT FORGING

FROM

HIGH STRENGTH ALUMINUM ALLOYS

Impact Forging is a mass production method of shaping high strength aluminum alloys by direct compression. This new production technique, perfected by Hunter Douglas, permits the use of heat treatable aluminum alloys in applications formerly designed to steel. Combined with the strength-weight ratio of aluminum, Impact Forging develops a forged grain flow to obtain maximum strength in each part.

Impact Forging can often produce the same part in one operation that formerly required multiple machining, and produce as a single piece a part that under ordinary methods required a number of smaller pieces assembled by threading, welding, or other secondary operations.

If you are designing a part for mass production with close dimensional tolerances and micro-precise surface finish, Impact Forging can be your answer. Hunter Douglas has had a vast amount of experience in making millions of high strength aluminum alloy forgings with great economies through simplified design. Find out how you can design for Impact Forging in place of machining, drawing, forging or casting. Forward your blueprints, specifications, or sample parts and let the Hunter Douglas engineering staff give you their analysis.

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THRIFTILY POWERED... HIGHLY AVAILABLE!

BOTH this G. E. 44-tonner and this Industrial Brownhoist crane have one thing in common that accounts for their high availability and low-cost operation. That's Caterpillar power—two D17000 Engines in the locomotive and a D13000 in the crane. They're reliable workers in the coal handling operation at the 180,000-KW plant of the Kansas City Power & Light Co., East Bottoms, Kansas City, Mo.

To save you money, an engine must run dependably with a minimum of upkeep and down time—not just when it's young, but for years. It must also produce its rated output without strain. Records *prove* that Cat* Diesels qualify on *all* counts. *Every* part is ruggedly built for long life. For example: crankshafts are heavy forgings of selected, pretested steel. Cylinder liners, rocker arms and all bearing surfaces are "Hi-Electro" hardened. Complete engine sealing keeps out destructive dust. And power ratings are conservative—the HP on the spec sheet is the HP delivered on the job, with good reserve. Another feature: these units use low-cost No. 2 furnace oil without fouling. All these and other factors add up to performance that will pay off for you!

Leading manufacturers can supply this power in the machines they build. Engines and electric sets, in 12 sizes up to 500 HP and 315 KW, provide the *right* power to meet your requirements. Ask your Caterpillar Dealer about replacement power and see how he backs these engines with *prompt* service—whenever needed. Call him today. Let him *show* you proof of performance!

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR*

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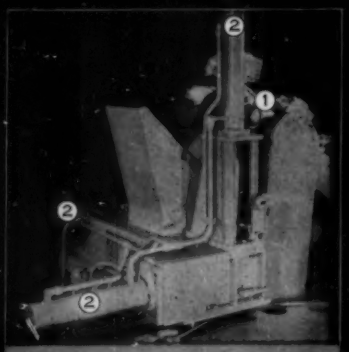
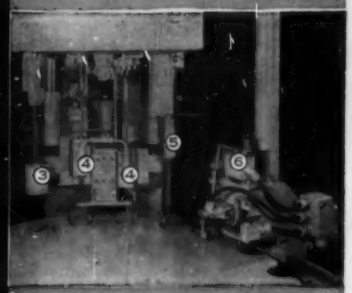
SPECIFY CAT POWER FOR HIGH-PROFIT PERFORMANCE

HOW W. F. & JOHN BARNES SPECIAL EQUIPMENT DESIGNING AND BUILDING SERVICE

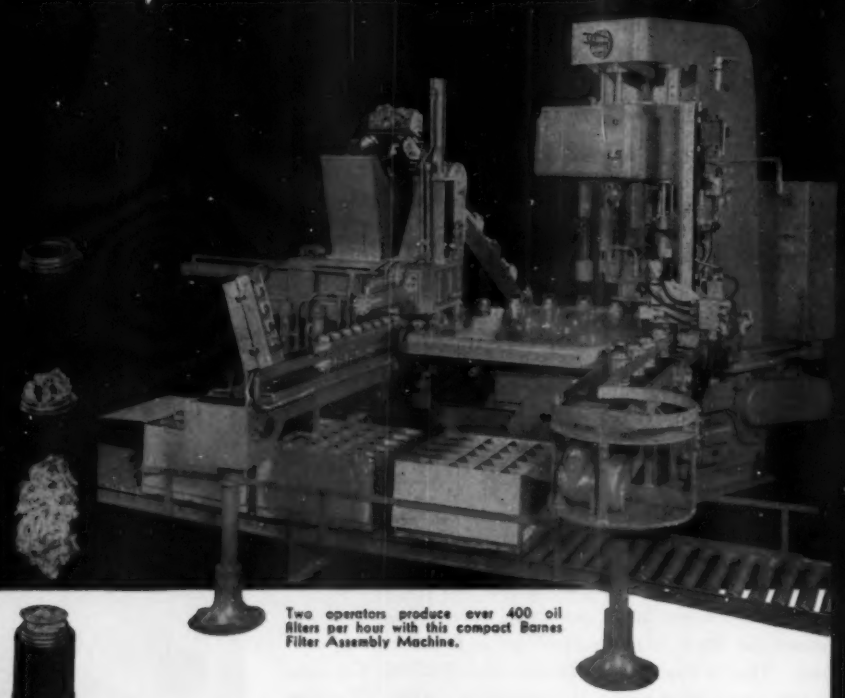
increased production 220% *through* AUTOMATIC ASSEMBLY *of oil filters*



Operator stationed at front of machine feeds empty cans from cartons at the left-hand side. Cans are automatically conveyed to star wheel. Second operator at rear of machine measures cotton waste, which conveyor (1) carries to hopper of compressing and loading cylinders (2). Same operator places wire screen and retainer on filter as it indexes to the next station.



Automatic plunger (3) forces screen and retainer into filter body. Two oscillating air drills (4) weave oil hole through cotton waste. Automatic gauge (5) checks depth of hole, ejecting defective units from machine. Next unit (6) automatically adds cork gasket to complete the assembly. Cartons are moved along conveyor to the discharge side of the machine, where they are repacked with completed filters.



Two operators produce over 400 oil filters per hour with this compact Barnes Filter Assembly Machine.

Oil Filter assembly production boosted from 125 to over 400 units per hour . . . that's the result story of this Barnes Filter Assembly Machine now at work for a large farm implement manufacturer. And equally as important, a higher-quality, more uniform product is being obtained with only one-third the personnel formerly required.

Once again the wide experience of W. F. & John Barnes Process Equipment Division has enabled another manufacturer to substantially reduce production costs and improve product quality. This special machine is only one of many widely diversified types now successfully and profitably cutting costs and increasing production output in hundreds of plants throughout the country.

Here at Barnes you'll find the varied engineering and creative skills, PLUS over 75 years of machine building background, to help you solve troublesome production problems. And because all planning, engineering, and manufacturing efforts are closely coordinated, you have available a complete *Automation Equipment Service* from one convenient and *experienced* source.

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Find out how these unique creative and specialized resources can help you cut costs. Your problem will be given expert and individual attention.

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W. F. & JOHN BARNES COMPANY

PROCESS EQUIPMENT DIVISION

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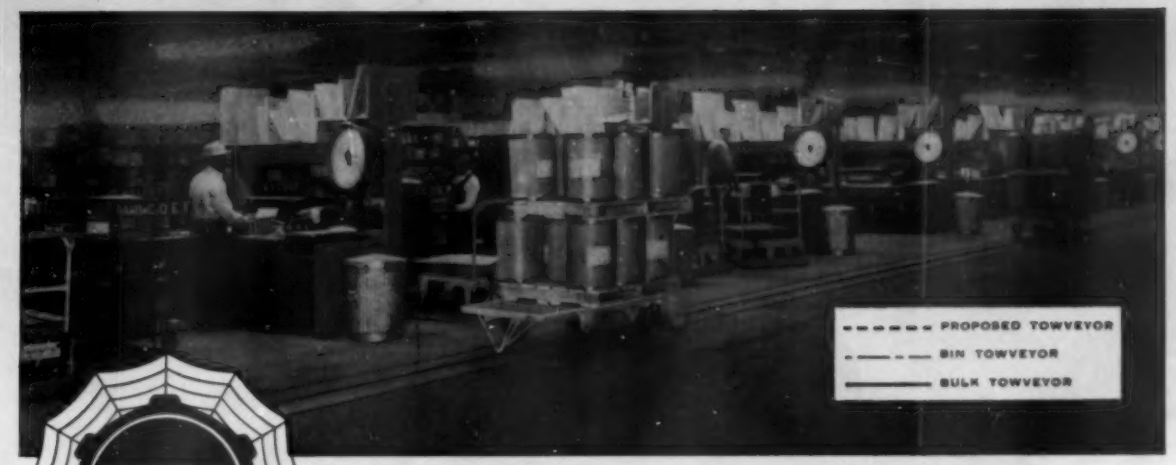
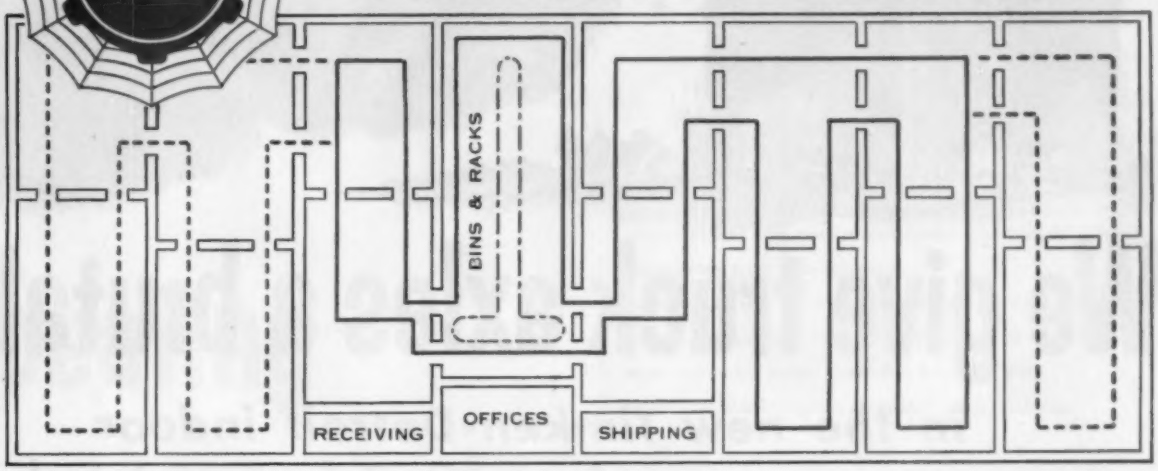
BUILDERS OF BETTER MACHINES AND EQUIPMENT SINCE 1872



WEBB

TOWVEYORS SERVE....



GENERAL SERVICES WAREHOUSE

Two Webb Towveyors serve the 1,000,000 square feet of floor space in the new General Services Warehouse at Franconia, Virginia. This warehouse handles 20,000 catalog items, and a normal volume amounting to $1,000,000.00 each month.

One Towveyor covering the bulk area is 8,156 feet long and the other located in the bin area is 1,110 feet long. The larger Towveyor has four drives, and a check by the power company shows a daily operating cost of 60 cents per drive.

In addition to catalog items, special orders for various Government Departments are also handled for in-and-out, or short storage only. The 600 Towveyor trucks employed come in very handy for this purpose and for short term storage of bulk items which are left on the trucks for reshipment without being floored.

The entire warehouse operation is so smooth running that visitors might at times get the feeling of little activity, but the tonnage figures and number of items handled daily erases this impression. A Webb Towveyor can smooth-out your material handling problems too—call your local Webb engineer for further information.

JERVIS B. WEBB CO.

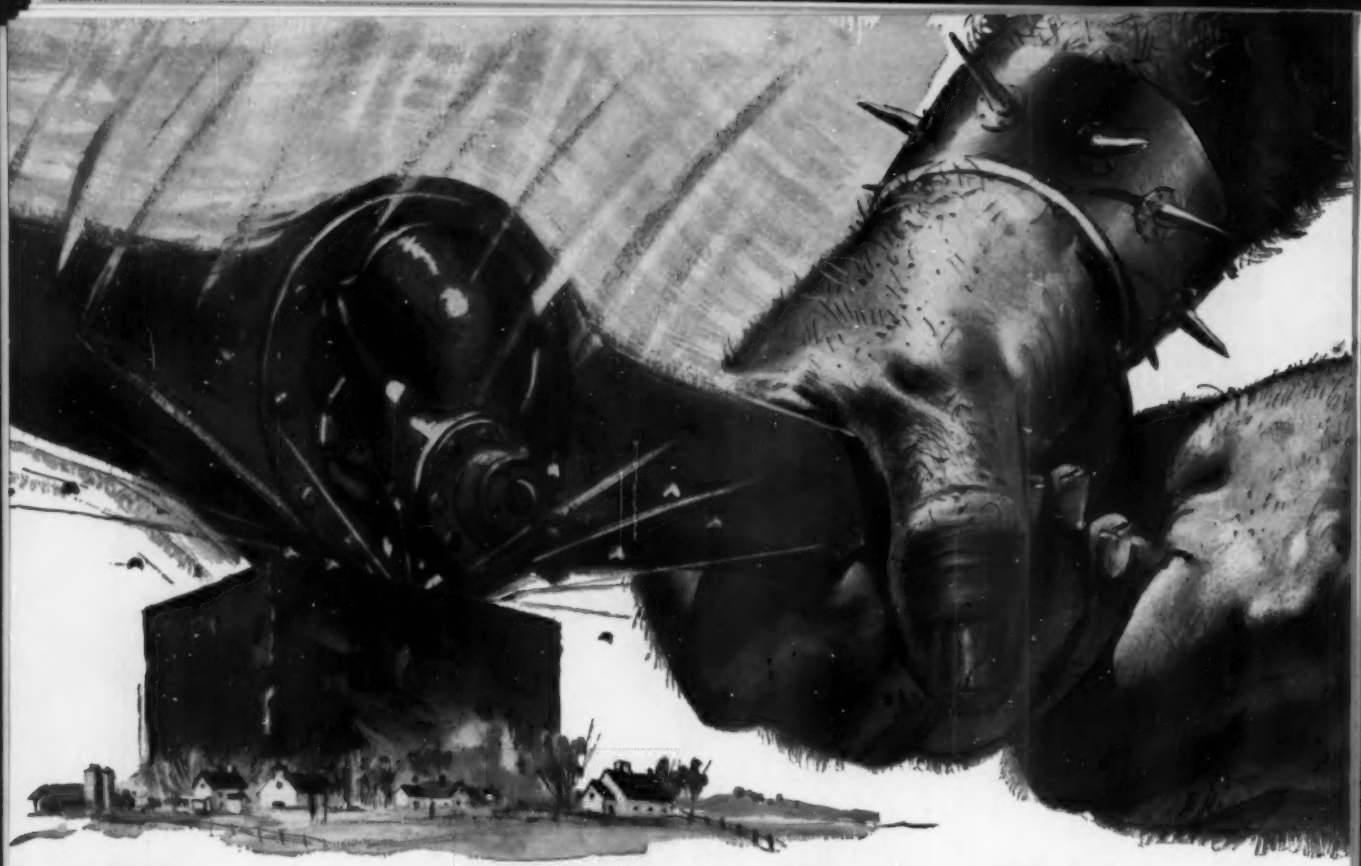
Conveyor Engineers and Manufacturers

8917 ALPINE AVENUE · DETROIT 4, MICHIGAN

Send for fully illustrated catalog that provides complete information on Webb floor type conveyors.

FACTORIES: DETROIT · LOS ANGELES · HAMILTON, ONTARIO

OFFICES AND REPRESENTATIVES THROUGHOUT THE WORLD



We give truck axles a brutal

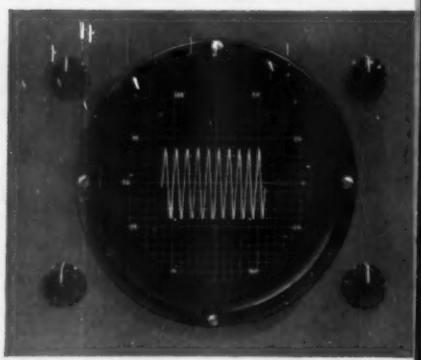
in the new Timken-Detroit indoor proving ground . . . and only

We torture them . . . shock-load, over-speed and jerk them . . . twist, strain and abuse them. We match every on-the-job hauling condition . . . then throw in a few devilish tricks of our own!

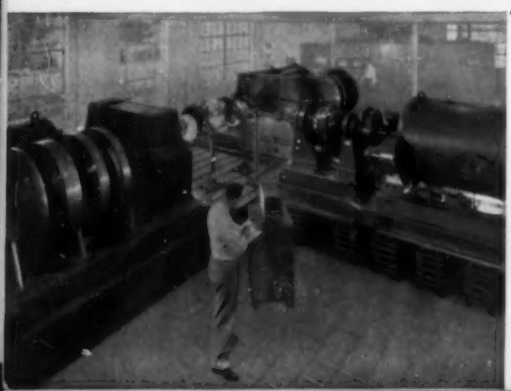
The result? You know for sure that *any* Timken-Detroit axle can take more abuse on the job it was built for than any other axle made!

To prove it, we moved a huge proving ground indoors. In one room we can simulate any hauling situation—our engineers can apply 50 years of experience to perfecting axles for modern trucks, buses and trailers, and measure performance with scientific precision.

This research pays off in longer truck life; less maintenance, repairs and downtime; lower operating costs. No wonder Timken-Detroit axles with Hypoid gearing rate "first" with wise truck owners!



Whatever you haul . . . simulated service conditions show up electronically on a screen like this. For instance—a heavily loaded truck on a bumpy, twisting road—then on a level express highway or long grade. What happens to the axle and gearing is measured, charted with absolute scientific accuracy.



TDA proves axle quality and performance in this "Torture Chamber"

Here we simulate actual highway conditions . . . test quality and performance of axles under any hauling situation, such as duplicating the kinetic energy of 80,000 lbs., G.C.W., at 60 m.p.h. All tests are repeated hour after hour with an automatic cycling control.

No matter the twist, thrust or shock . . . Timken-Detroit axles can take it! Regardless of load, road and speed conditions . . . even the impossible . . . the new Timken-Detroit Straight-Line Drive for the 2½-ton, 6 x 6 military truck is a vastly improved unit.

On Timken-Detroit axles . . . you go anywhere you gotta go . . . and with power and stamina. You can't be choosey in combat . . . and you can't afford breakdowns in schedules *or* the vehicle. And every day, continuous research is adding even greater performance to the 6 x 6.

What's more . . .

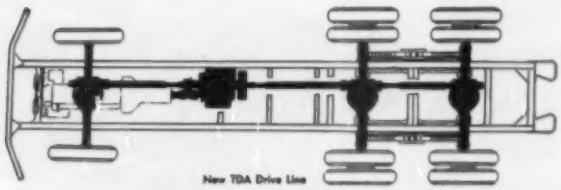
INTERCHANGEABILITY . . .

of parts for easier logistics

1. **A simpler logistics problem of stowage and palletizing.**
2. **Fewer different parts in stock bins — of vital necessity to military supply officer who must maintain a warehouse on wheels.**
3. **Far greater ease of maintenance.**
4. **Fewer records of parts and service operations to maintain.**
5. **Reduced personnel training time in operation and maintenance.**
6. **More personnel made available for other duty.**
7. **Faster availability between manufacture and use.**

beating

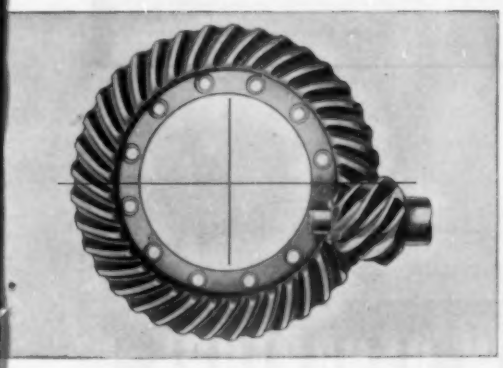
Timken has it!



New TDA Drive Line

Here's what makes the Timken-Detroit 6 x 6 assembly "tick"

The new design features a straight-line drive from the front axle through the transfer case to *both* rear axles. This is possible because top-mounted double-reduction final drives are used on all three axles. Ground clearance is increased . . . propeller shaft angles reduced vertically and horizontally.



Hypoid . . . Timken-Detroit's "baby" . . . proved in billions of ton-miles of service. Slower gear ratios without loss of strength. Larger bearings . . . bigger, stronger offset pinion . . . more teeth in contact . . . torque transmission increased. Available in world's only complete axle "family" . . . single-speed; single-speed, double-reduction; 2-speed double-reduction final drive units, in 7 basic capacities covering entire range of medium and heavy-duty requirements.

TIMKEN Detroit AXLES

TIMKEN-DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

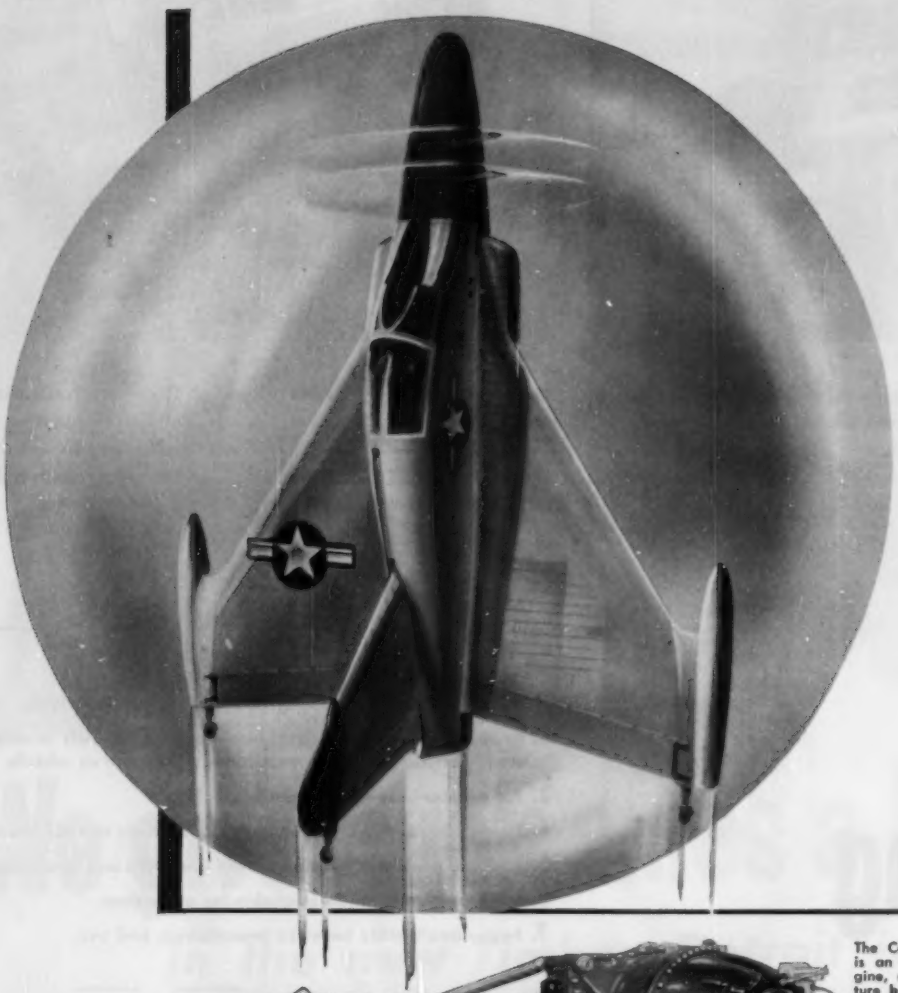
Accepted TDA Standard

TRADE MARK REGISTERED

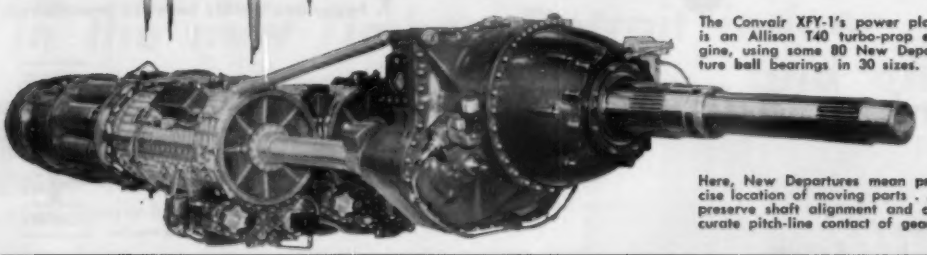
"TORTURE-TESTED" to Save Money on the Job

WORLD'S LARGEST MANUFACTURERS OF AXLES FOR TRUCKS, BUSES AND TRAILERS

Plants at: Detroit, Michigan • Oshkosh, Wisconsin • Utica, New York
Ashtabula, Kenton and Newark, Ohio • New Castle, Pennsylvania



The Convair XFY-1's power plant is an Allison T40 turbo-prop engine, using some 80 New Departure **ball** bearings in 30 sizes.



Here, New Departures mean precise location of moving parts . . . preserve shaft alignment and accurate pitch-line contact of gears.

BEARINGS for a "Pogo" Pilot

Vertical take-off! Tailfirst landing! Fighter action! It's the Navy's newest—the Convair XFY-1 "pogo stick."

In its Allison T40 turbo-prop engine, some 80 New Departure **ball** bearings assure positive positioning of moving parts. And in the hub mechanisms of the Curtiss-Wright Turbolectric propellers, New Departures carry heavy loads.

Throughout defense and industry, you'll find New Departure **ball** bearings ideal for countless applications. So whatever your bearing problem, *talk with your New Departure engineer . . . now!*

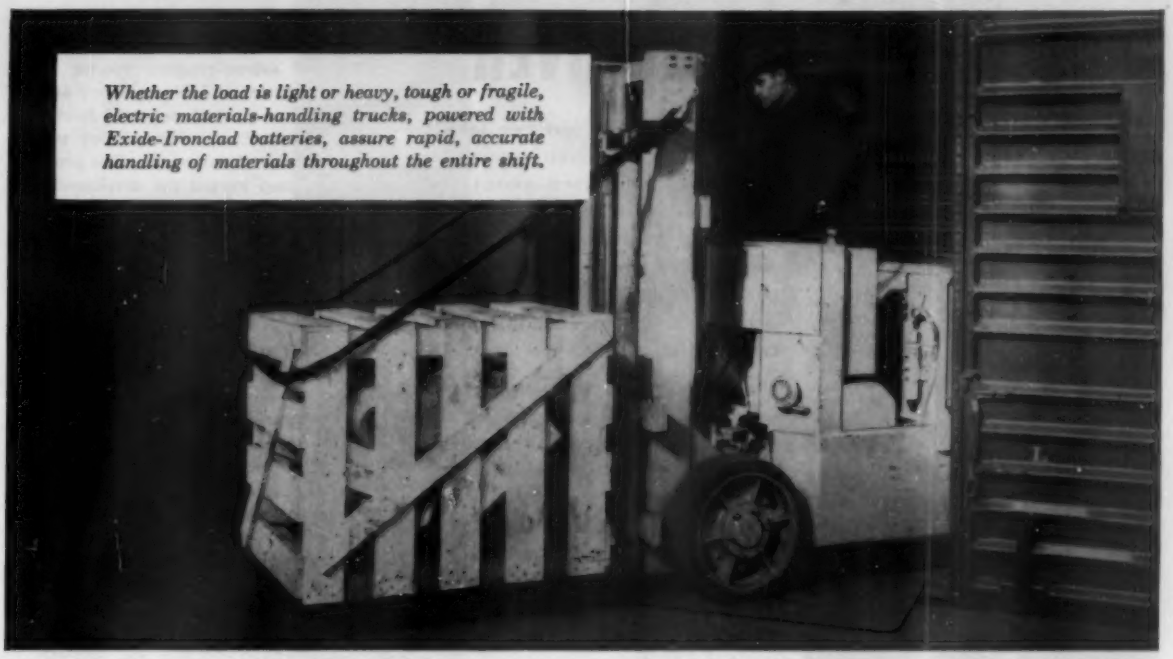
NOTHING ROLLS LIKE A BALL

NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
Plants also in Meriden, Connecticut, and Sandusky, Ohio
In Canada: McKinnon Industries, Ltd., St. Catharines, Ontario

GET FULL SHIFT HANDLING, NO UNSCHEDULED DOWN TIME

. . . with low cost Exide-Ironclad power!



Whether the load is light or heavy, tough or fragile, electric materials-handling trucks, powered with Exide-Ironclad batteries, assure rapid, accurate handling of materials throughout the entire shift.

YOU GET uniform performance throughout each shift when battery electric trucks are powered by Exide-Ironclads. Your trucks handle as much load during the last hour as during the first . . . with no unscheduled down time. Lower costs for operation, maintenance and depreciation make Exide-Ironclads your best power buy—AT ANY PRICE!

THE POSITIVE PLATES are the heart of any battery. Only Exide uses a slotted tube construction. By use of tubes, more active material is exposed to the electrolyte, providing *greater power*. Also, more active material is retained, giving *longer working life.*

THE NEW THRIFTY HAULER! The improved industrial truck battery. *Non-oxidizing* plastic power tubes assure longest battery life, more capacity in the same space. For full details, call your Exide sales engineer—write for Form 1982 (Installation and Maintenance of Motive Power).

Your best power buy
. . . AT ANY PRICE!

Exide®
IRONCLAD® BATTERIES

Exide INDUSTRIAL DIVISION, The Electric Storage Battery Company, Philadelphia 2, Pa.

Anchor Ducts to Concrete and Cut Your Costs Up to 80% with the REMINGTON STUD DRIVER

"Paid for itself in just two jobs." Reports like this keep coming in from sheetmetal men about the Remington Stud Driver. They're setting up to 5 studs a minute in concrete and steel with this amazing powder-actuated tool. Savings run as high as 80%, compared to conventional fastening methods!

Economy like this gives your maintenance crew a definite advantage. They can speed up the job . . . get more work completed. And they can tackle almost any fastening job. Completely self-powered, the Stud Driver requires no outside source of power—no troublesome wires or cables. Its light weight and compact size bring every job within easy reach.

It will pay you to get all the facts about the Remington Stud Driver. It's been test-proved to be the world's speediest fastening system and can help you save money on the job—do the job faster and easier than ever before. Just send in the coupon for complete information.

Questions You Are Asking

QUESTION

What caliber cartridge powers the Stud Driver?

ANSWER

32-caliber cartridges in six graded power loads are available. Colored heel caps make it easy to select the best power load for each job.

MAIL THIS COUPON TODAY

Industrial Sales Div., Dept. O-9
Remington Arms Co., Inc.
Bridgeport 2, Conn.

Please send me a *free* copy of the new booklet showing how I can cut my fastening costs.

*Name*_____

*Position*_____

*Firm*_____

*Address*_____

*City*_____ *State*_____

"If It's Remington—It's Right!"

Remington

DU PONT

Listed and Approved by Underwriters' Laboratories, Inc.

ATOMIC ENERGY

NEW REACTOR ANNOUNCED

The first sodium-graphite reactor in the United States will be developed and constructed in a project sponsored jointly by the Atomic Energy Commission and North American Aviation, Inc. The project, a new step toward the development of economic nuclear power, will cost about $10 million.

The reactor will be an experimental model of a full-scale power reactor already in the preliminary design stage. It will use metallic fuel elements of either slightly enriched uranium or a combination of thorium and uranium 233. It is expected to be in operation by mid-1957.

North American Aviation, which has been the principal contractor of the AEC in the development of the sodium-graphite reactor, has agreed to assume up to $2.5 million of the total cost and to supply the reactor site, at no cost to the Government, near the company's field test laboratory in the Santa Susana Mountains, north of Los Angeles, Calif.

The company also will operate the reactor plant experimentally for approximately two years under terms of a recently signed contract with AEC. Title to the equipment will remain with the Government.

The present project will resemble the full-scale plant designed by the company but will generate only about 20,000 kilowatts of heat. The plant will have no electricity-generating equipment.

In addition to its sodium-graphite development work North American Aviation has built two low-power "water-boiler" homogeneous reactors for the AEC—one at the company's Downey, Calif., plant and one at the AEC's research facility at Livermore, Calif., which is operated by the University of California.

The sodium-graphite reactor is one of five types on which the AEC is concentrating in its 5-year program for the development of economic nuclear power. Another type is the pressurized water reactor which will be placed in the recently authorized central station power plant of the AEC and the Duquesne Light Company near Pittsburgh. The other reactor types are the homogeneous, the fast breeder, and the experimental boiling water reactors.

REACTOR AT MICHIGAN

The Atomic Energy Commission has approved the allocation of fissionable material as fuel for a nuclear reactor to be built by the University of Michigan.

The "swimming pool" type reactor will

The pole that need not be climbed

Fastening wires with new tool.

Since telephony began, there has been just one way to install telephone wires on poles: have a trained man climb up and fasten them there. Now Bell Laboratories engineers have developed a special pole line for rural areas. The entire line can be erected without climbing a pole.

The whole job is done from the ground. Light-weight poles are quickly and easily erected. Newly created tools enable men to fasten wires to crossarms 10 to 25 feet over their heads.

This inexpensive line promises more service in sparsely populated places. From original design to testing, it exemplifies a Bell Telephone Laboratories team operation in widening telephone service and keeping costs down.

Key to the new "climbless" pole is this insulator. Ground crews use long-handled tools to place the wire in position and then lock it fast.

Bell Telephone Laboratories

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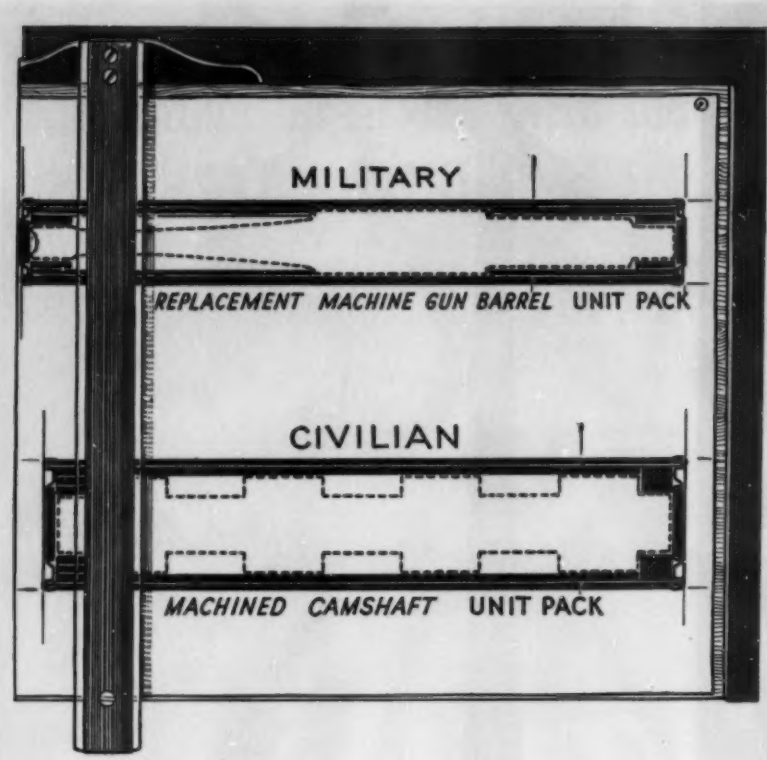

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be used for the training of engineers and for research sponsored by the university and by industry. It will be part of the Michigan Memorial-Phoenix Project which has been established with private endowments for studies of the peacetime implications and applications of atomic energy.

The reactor will be cooled and moderated with ordinary water and will use enriched uranium fuel. The fuel elements will be suspended in a pool of water sufficently deep to serve as a shield against the radiation produced by the reactor.

Oak Ridge National Laboratory will review the reactor design and operating plans for the university. A similar "swimming-pool" facility, the bulk shielding test reactor, has been in operation at Oak Ridge since 1952. Experience has demonstrated that this type of reactor is safe to operate and easy to maintain.

ISOTOPES AVAILABLE

Stable, or nonradioactive, isotopes produced in facilities of the Atomic Energy Commission will be available for foreign distribution under a program recently announced by the Commission.

Radioisotopes have been sold to foreign users by the Commission since 1947, but stable isotopes generally have been available only to users within the United States. About 175 stable isotopes of nearly 50 elements are produced by the AEC. Stable isotopes, like radioisotopes, are valuable tools for basic research in various scientific fields.

A total of 48 foreign countries have been authorized to receive radioisotopes produced in the United States, and approximately 2,500 foreign shipments of radioisotopes have been made. Foreign requests for stable isotopes will be forwarded to the Commission through the official representatives of foreign nations for radioisotope procurement.

The terms and conditions for obtaining stable isotopes will be the same as those which now apply to foreign requests for radioisotopes. The applicant must agree to use the isotope only for the purpose stated in the application and also must agree to report research results to the AEC. Foreign countries may obtain isotopes for scientific, medical, and industrial research, medical therapy, and industrial utilization.

Stable isotopes will be sold at prices which will recover full costs of production. The quantity of a stable isotope approved for export will be limited to the amount generally provided to a domestic user for a similar purpose.

Although some stable isotopes have been produced since the 1930's, pre-World War II techniques for the concentration and separation of stable isotopes were im-

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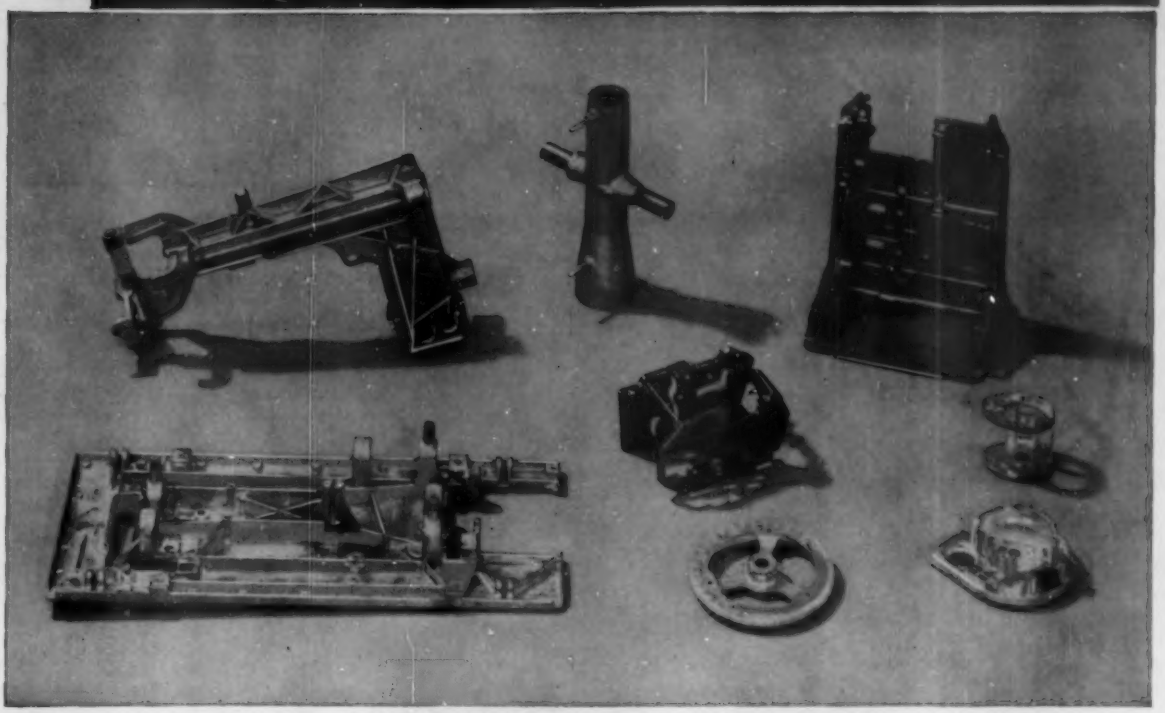

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practicable for most elements, and only very minute quantities of pure separated isotopes could be obtained.

Electromagnetic separation was one of the methods used during World War II to separate the uranium-235 isotope, needed for atomic weapons, from the more common uranium-238 isotope. This method no longer is used for uranium separation.

However, part of the electromagnetic separation plant at the Oak Ridge National Laboratory has been utilized for the production of stable isotopes for research in quantities much greater than were available before. Most stable isotopes now are produced by electromagnetic separation.

Stable isotopes have various research uses. Some elements do not have radioisotopes with half-lives long enough to make their use feasible in experiments. Stable isotopes of these elements can be used in tracer experiments. Boron-10 is useful as a neutron detector. Deuterium, the stable heavy isotope of hydrogen, has been utilized in biological and chemical studies. Helium 3 is important in low-temperature studies.

A miniature gage which will enable scientists to make more efficient studies of pressures resulting from nuclear explosions has been developed at the Armour Research Foundation of the Illinois Institute of Technology, Chicago.

The pressure gage, probably the smallest of its kind ever made, can measure pressures as low as those from a breeze to those that would demolish the sturdiest of buildings. Its chief use at present is in small models used in laboratory studies of atom bomb blasts.

Several of the foundation's projects were set up to gather information about the effects of atom-bomb blasts—without using atom bombs—and information on blast effects was obtained by the use of a shock tube. This is an 18-foot-long tube with an 8-inch-square cross section. Tubes of other dimensions are also in use.

Air pressure is built up in a chamber at one end of the tube, then released suddenly when a plastic partition is pierced. This produces a pressure wave, or shock wave, which travels down the tube and simulates an atomic blast. A model is mounted at the far end of the tube, and the tiny pressure gages are installed at a number of points on the surface of the model to measure the blast effects.

One of the gage's most important characteristics is said to be almost instantaneous response to changing pressures.

In operation the gage converts blast pressures into electrical voltages. The electrical output varies with the amount of pressure the gage senses, and the voltage actuates a recording device.

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ADM. ROBERT B. CARNEY, U.S.N.

Chief of Naval Operations

Command of the Sea

The Traditional Rôle of the Navy in the Defense of America

Adm. Robert B. Carney, U.S.N., the present Chief of Naval Operations, was graduated from the United States Naval Academy in 1916. He was gunnery and torpedo officer on the U.S.S. FANNING when she captured the German U-58 in November 1917.

He served extensively at sea on destroyers and on staffs. Ashore he was an instructor at the Naval Academy, plans officer at the Naval Gun Factory, and in the Fleet Training Division, Office of the Chief of Naval Operations.

For two years preceding World War II Admiral Carney assisted in the coördination of the Navy's Small Craft Program in the Office of the Assistant Secretary of the Navy. During World War II, he commanded the cruiser DENVER and was chief of staff to the Commander, South Pacific Forces. Later, as chief of staff to Admiral Halsey, Commander, Third Fleet, he planned fleet operations in connection with the invasion and protection of the Philippines.

From 1946 to 1950 Admiral Carney was Deputy Chief of Naval Operations for Logistics and then assumed command of the Second Fleet for a short period until he was assigned as Commander in Chief, U.S. Naval Forces, Eastern Atlantic and Mediterranean.

Prior to being appointed Chief of Naval Operations in August 1953 Admiral Carney was Commander in Chief, Allied Forces, Southern Europe.

He was awarded the Navy Cross, the Distinguished Service Medal three times, and the Legion of Merit for his fearless actions and brilliant planning in World War II.

THE Navy's historic rôle has been to secure command of the sea. Our fleets have expanded in some eras and shrunk to insignificance in others as the threat from overseas powers rose and fell.

In the mid-nineteenth century, while a friendly Great Britain ruled the seas, we had no fleet and were forced to amazing improvisations to conduct our coastal operations during the War between the States. As the German and later the Japanese fleets expanded, ours were increased comparably.

At present, overriding seapower rests with the United States and Great Britain although the Russian Navy now ranks second in tonnage to the U. S. So the question may arise as to why this country maintains large fleets in the Atlantic and the Pacific.

IN this troubled world with two great alliances of opposing ideologies engaged in a cold war, what is the Navy's function? What is the Navy's rôle if we become engaged in war with a great power concentrated on land and independent of sea communications?

Our Air Force can devastate an aggressor's industry by strikes over long distances from many bases at home and overseas. Our Army is essential to drive back opposing armies and occupy the ground. The Navy has the vital task of maintaining command of the sea so that it can strike an enemy from any point off his coastline and maintain our lines of communication to overseas bases.

The Navy must be ready to drive hostile fleets from the seas. Then its carrier task forces can strike great distances inland with their aircraft from dispersible floating bases. Bombardment forces or guided-missile ships and submarines can hurl missiles deep into enemy territory from the sea. Amphibious forces can launch an invasion or turn an enemy's flank.

In the pursuit of these major operations it will be necessary to keep the sea lanes open and to protect our floating bases by the constant vigilance of antisubmarine units.

Our Sixth Fleet in the Mediterranean is an example of naval power alert to its rôle and a visible deterrent to aggression. As early as 1946, James Forrestal, then Secretary of the Navy, announced that we would maintain naval forces in the Mediterranean to support our national policy.

In 1948 these forces were increased to a formidable unit and designated as a task fleet. They remain constantly in the Mediterranean as a warning to all would-be trespassers that the United States is prepared to back up its allies instantly with naval power.

Similarly, in the Pacific we have witnessed the effectiveness of a fleet in support of a land operation in the Korean war.

THE man who directs the far-flung naval forces of this Nation is Adm. Robert B. Carney, Chief of Naval Operations. From his headquarters in the Pentagon he sets policies that guide all naval operations—fitting naval operations into the over-all scheme of military operations through his position as a member of the Joint Chiefs of Staff.

Admiral Carney must not only keep the fleets at top fighting efficiency but must see to it that they have modern weapons that take full advantage of scientific developments.

There is a constant search, a continuous demand on our scientists and technologists for more effective and higher-powered weapons to insure that our naval strength remains supreme.

The Navy also depends heavily on strong industrial support to produce its weapons in the quality and quantity required. To meet these needs, the American Ordnance Association always stands ready and willing to assist the Navy by all the means at its disposal.

New Army Organization

A plan for making today's Army more efficient and effective

Hon. John Slezak
Under Secretary of the Army

THE need for improvement in Army organization has been evident for some time. A radical reorganization has been necessary for each of the two major wars in this century. Various congressional hearings, including the ammunition hearings, have pointed up major deficiencies.

Before taking leave of his office as Secretary of Defense, Robert Lovett, in his report to the President, indicated a special need for reorganization of the Army in those portions of the logistics field which are covered by the individual Army technical services. The Rockefeller Committee stressed the need for reorganization within the military departments, including the Army.

The Secretary of the Army's Plan for Organization is based on experience of the most highly qualified people in the organizational field, both inside and outside the Army. The plan synthesizes the results of a great many formal and informal studies, analyses, and evaluations.

IN late 1953, pursuant to the study by the Rockefeller Committee which laid the groundwork for the President's Reorganization Plan No. 6 of 1953 covering the Department of Defense, the Secretary of the Army appointed an Advisory Committee on Army Organization. The members of the committee were:

Paul L. Davies (chairman), president, Food Machinery and Chemical Corporation, San Jose, Calif.; C. Jared Ingersoll, chairman of the board, Muskogee Company, Philadelphia; Harold Boeschenstein, president, Owens-Corning Fiberglas Corporation, Toledo; Irving A. Duffy, vice-president, Ford Motor Company, Birmingham, Mich.; and Lieut. Gen. Lyman L. Lemnitzer, Deputy Chief of Staff for Plans and Research, Department of the Army.

This committee made an intensive study during the period from September 1953 to January 1954 and made important recommendations. The Secretary of the Army's Organization Plan, now approved, incorporates the major portion of the organizational reform embodied in the recommendations made by the Davies Committee. Without the dedicated work of the committee members, the progress in Army organization being made at this time would not have been possible.

The studies, analyses, and evaluations made over the years have revealed four major general conclusions:

1. The need to reorganize the top structure of the Department, so the Army can function as a truly effective member of the Defense team.

2. The need to realign the organizational structure in order to make possible an effective professional partnership between the civilian and the military within the Army—one which will provide true civilian control and, at the same time, truly effective military operations.

3. The need to achieve the flexibility of organization which will enable the Army to function effectively in peace and in war and function well in the environment and with the type of people which will be available to us in accomplishing our mission.

4. The strictly military aspects of the Army's activities, and the combat functions themselves, have always absorbed the major interest of the Army's top personnel, civilian and military. As a result, superb combat arms officers, troops, and tactics have been developed. Over many years this combat type of thinking has predominated.

This article is based on the presentation of the Secretary of the Army's Plan for Organization made at the annual Secretaries' Conference with the President, Quantico, Va., June 18, 1954.

ALTHOUGH with the change in the character of warfare the major logistics activities of the Army have become progressively more and more important to the total effectiveness of the Army, these logistics activities have become more and more subordinate in the organizational arrangements and in the operations of the Army Establishment.

The organization plan which the Secretary of the Army has developed gives major attention to the correction of these four defects. The plan proposes changes in the top structure, which will relate the Army properly to the Department of Defense and make the Army a true member of the Defense team. It proposes other changes in the top structure and in the internal structure which will correct other defects. I shall discuss these in some detail.

As will be seen by referring to the chart on page 204, the new organization realigns the structure of the Army in such a manner as to permit the Secretary to function as the chief executive of the Army Establishment, and it gives him the organizational tools he needs for this purpose.

Because the Army not only has the function of doing its job but is also a public institution, it must interpret

itself and explain and justify its activities to the public and the Congress. So the Secretary of the Army, as part of his over-all control, must be intimately tuned in with and control the Army's relationship to the public in general and the Army's relationship to the Congress. So the Office of Public Information and the Office of Legislative Liaison are being placed under the immediate control of the Secretary.

Also, the General Counsel reports directly to the Secretary, and the Secretary has an administrative assistant.

In order to have true civilian control the Secretary must have, as a minimum, civilian appointees for the functional control of the major areas of personnel, money, and matériel. In addition, if the Secretary of the Army is to be its true general manager, he has urgent need for an intimate deputy—an *alter ego,* to assist him in this field.

Also, the tremendous and growing importance of the worldwide military aspects of civil functions can neither be delegated to the military nor handled adequately with the existing number of Assistant Secretaries.

ACCORDINGLY, a request has been made to the Congress for the authorization of two additional Assistant Secretaries. To one, the Secretary plans to reassign responsibility in the research and development and logistics area—relieving the Under Secretary of this responsibility and thus freeing the Under Secretary to assist the Secretary and to act as his deputy.

The second new Assistant Secretary will undertake the tremendous complex of intertwined civil-military functions, including the Canal Zone Government, the Panama Canal Company, the Alaska Communications System, Civil Functions of the Army, civil affairs and military government, psychological warfare and so on. Assistant Secretaries are already functioning in the personnel and financial fields.

The four Assistant Secretaries will act for and with the authority of the Secretary. They will all have direct and intimate working relationships with the subordinate agencies of the Army in discharging their functional responsibilities in their respective fields.

The Chief of Staff will have, as he has now, *"supervision of all members and organizations of the Army"* as is provided by law. This provision of law is given full force and effect by the fact that the Comptroller of the Army and the Deputy Chiefs of Staff shall report and be responsible to the Chief of Staff.

If at any time the Chief of Staff finds himself in conflict with the instructions of any of the Assistant Secretaries in the discharge of their responsibilities for functional control, the Secretary or the Under Secretary will resolve the differences.

We propose to set up primary working relationships between the top civilian executive structure of the Department of the Army and civilian officials of the Department of Defense. These primary liaison relationships should materially speed and harmonize the transaction of business between the two levels of organization.

Some extremely important changes are being made in the internal structure of the Department of the Army. Responsibility is being assigned more on a mission basis than has been possible in the past. The two major mission areas are, first, tactical personnel and operations; and, secondly, logistical personnel and wholesale-level logistical operations.

It was primarily the weakness in our organization for logistics which caused the major reorganizations in World War I and World War II. Our organization must be arranged for effective performance in both war and peace. It must be possible of rapid expansion and contraction. Therefore we should not delay longer in taking action to improve our organizational structure.

Where, previously, just below the Assistant Secretary and Chief of Staff level we had the Comptroller of the Army, the Deputy Chief of Staff for Administration and Operations, and the Deputy Chief of Staff for Plans and Research, we now recognize the present importance of logistics by providing a new Deputy Chief of Staff for Logistics.

By grouping the Army General Staff and the Continental and Overseas Commands organizationally as a major mission area, we fully protect the excellence of our combat forces and the performance of the combat functions.

But some adjustments are needed in this area. It has long been recognized that the Chief of Staff does not have a mechanism which will give him coördinated control of the continental army areas. The armies now receive fragmented and diffused direction from the various elements of the General Staff.

IT is generally agreed, throughout the various organizational studies, that we should set up a Continental Army Command which would have control of the six continental armies and the Military District of Washington. This is being done.

The Continental Army Command will perform all the functions now charged to the Army Field Forces and in addition will direct and control these armies for the Chief of Staff. Authority and responsibility will be concentrated in the continental army commander. Clean-cut lines of accountability are thus established, and performance can be evaluated on a coördinated, mission basis.

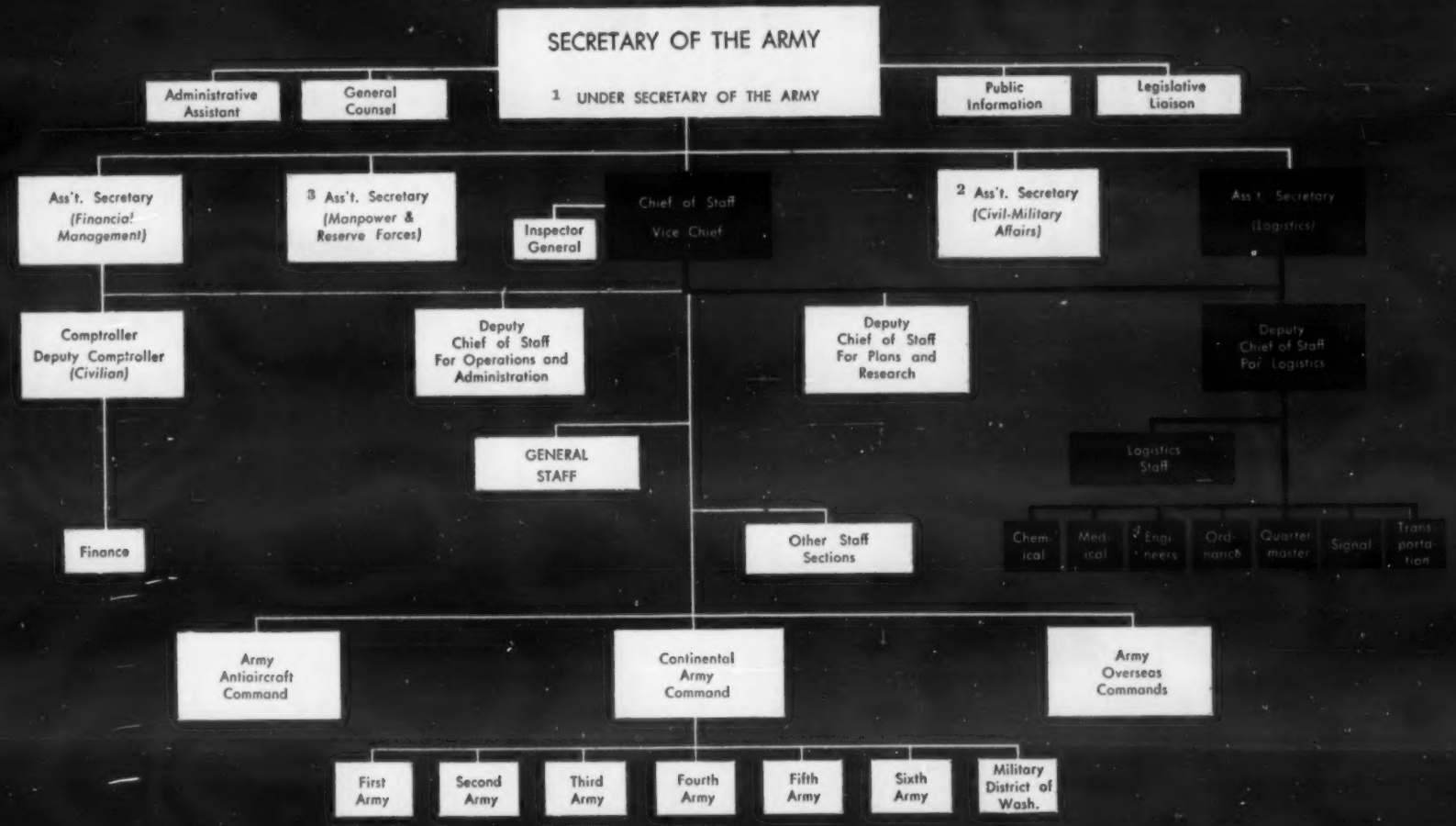
We are also taking steps to strengthen research and development. Control of this at Army Staff level is being placed on the military operations side—with the "user," where it belongs. It will be under the Deputy Chief of Staff for Plans and Research.

As this organization plan is put into effect, the General Staff will be relieved of many of its operating functions. It will thus be freed to perform its function as a true *military* General Staff.

The seven technical services of the Army embrace almost the entire field of wholesale-level logistics—both the matériel itself and the logistics services such as construction, communications, and so on.

By grouping the technical services under the Deputy Chief of Staff for Logistics, for the first time we provide,

NEW ORGANIZATION OF THE ARMY



1 Controls Management, Statistics and Review.

2 Relations, Reserve, Civil Functions, Political-Military, Economic Affairs.

3 Direct working relationships with technical and military personnel elements of Army Staff.

4 Additional direct responsibilities to Assistant Secretary (Civil Military Affairs)

This organization was announced by the Secretary of Defense on June 17, 1954. In preparing the chart for publication the editors have placed emphasis on the supply organization.

on a permanent basis, for the effective development of the over-all logistics structure of the Army for the service of the combat forces.

What is just as important—we provide an organizational arrangement which will, for the first time, make possible the systematic development of professional *logisticians,* so that we can expect to improve the quality of our *performance* of logistics operations.

We now have arrangements for the development of excellent combat officers and for the development of excellent technical and professional specialists. The hearts of the combat officers are usually with troops and operations. Logistics to them is a less attractive career field than military operations.

The natural source of officers from which to develop true logisticians would be from among those who have already devoted their primary interest and attention to the performance of parts of the logistics function. Some of these officers will always wish to remain technicians or professional specialists, and arrangements must be made to permit them to do so—both for the sake of those officers and, even more important, for the effective performance of the technical and professional functions which are so necessary to the accomplishment of the Army's mission.

BUT some, who have major capability in this tremendous business and industrial area of the military and who have chosen the logistics side of the Army—even as segmented among the technical services as it is now—as their career, have long felt the restrictions upon their development and advancement.

By enabling these officers who wish to become generalists and top managers in the logistics field to do so, through the control of their careers by the Deputy Chief of Staff for Logistics, we shall then have the opportunity to attract into the logistics field those who have the aptitude for it and the tremendous individual capabilities which are needed if we are to correct the long-standing deficiencies in our logistics operations.

It has been stated that there was more matériel in the pipeline at the end of World War II than was used up, or shot up, or worn out, during all the combat operations. We know we cannot afford this type of wastefulness now or in the future.

THE only way we are going to get top-notch management in the logistics area is to make a logistics career sufficiently attractive so that some of our best people will choose it. With the opportunity for promotion on the logistics side up to, and including, the position of Deputy Chief of Staff for Logistics, we have made a real beginning toward solving that problem.

The Secretary of the Army and the Chief of Staff can require effective performance in the logistics field by giving the Deputy Chief of Staff for Logistics command control over the technical services in all aspects of their organizations and operations and by giving the Deputy Chief of Staff for Logistics full control of all the resources needed by the technical services in the performance of their missions. Under this type of arrangement it will, for the first time, be possible to achieve a balanced management of the logistics functions and to take corrective action before crises develop.

Our activities in the wholesale industrial-commercial or logistics area in the overseas commands are perhaps as tremendous as they are in the continental United States. For the Secretary of the Army and the Chief of Staff, the Deputy Chief of Staff for Logistics will exercise *staff* supervision over these functions.

Naturally, with the tremendously important mission assigned to him, the Deputy Chief of Staff for Logistics will need a competent Logistics Staff to assist him. Provision is made for this, as shown on the organization chart on the preceding page.

This organization plan will permit us to clarify and perfect our financial management or comptroller functions. We are already far along with this. What we shall do now is to concentrate effort on the integration of the thirty or so accounting systems.

We shall realign our programming, budgeting, and accounting so that they follow the lines of organizational responsibility. We shall relate the various recording and reporting structures for budget, for accounting, and for programming so that we have the tools for balanced management at all levels throughout the Establishment—management that is suited to the mission being performed in each instance.

Obviously, the techniques will differ, as between the military operations side and the predominately industrial-commercial activities on the logistics side. The differing needs of the two mission areas must be taken into account.

The Office of the Chief of Finance will be made directly responsible to the Comptroller. This will clarify responsibilities in the comptroller field, and it will permit the broadening of the career horizon of Finance Corps officers.

FINALLY, this plan will place the Inspector General under the immediate control of the Chief of Staff, rather than as a staff element subordinate to the Deputy Chiefs of Staff level. The Inspector General is the Chief of Staff's personal agent in determining whether policies are being complied with, whether regulations are being adhered to, whether established procedures are being followed, whether operations are proceeding in the manner the Chief of Staff believes they are. So you can see why it is important that he be directly responsible to the Chief of Staff.

In summary, the Army does not claim that this reorganization plan is the perfect answer to all our problems nor that it is an organization which is good for all time. We believe that it is a tremendous step forward in making the Army efficient and effective in the present-day world.

Naturally, there is much still to be worked out. Naturally, also, we shall continue to look for ways to improve and perfect Army organization and operations as a member of the Department of Defense team and in the service of our Nation.

What of the H-Bomb?

(Air Force photo)

Maj. Gen. J. F. C. Fuller

BECAUSE war is a political instrument and weapons are military instruments it logically follows that the introduction of a new weapon or the adoption of a new means of waging war must carry with it a political significance.

Hitherto no considered attempt has been made to tackle this problem, and new weapons and means have been introduced without thought of their political consequences. This has been due not so much to the difficulty of probing the future as to man's ineradicable dislike of the unconventional and his abhorrence of change.

Nevertheless when, after years and sometimes centuries of blind trial and error, the political significance of a new weapon becomes apparent, it is seen that even at the time of its adoption the forecasting of its political influence was in no way an insuperable problem.

Furthermore, had a forecast of no more than a modicum of accuracy been made when the new weapon or means was first introduced, the blind trail of trial and error could have been considerably curtailed.

In order to establish a background to this really vital problem, let us turn to the discovery of gunpowder and the introduction of firearms during the late Middle Ages and ask ourselves: What was their political significance? To clarify this question, we must first make certain of its background; that is, we must examine the character of warfare which preceded this radical change.

Once Europe had been Christianized and the Church had established its dominion, in its wisdom it realized that, although it could not eliminate war, it could mitigate its destructiveness by restricting it to disputes between the aristocracy; that is, by ennobling war and therefore deprolitarianizing it.

THIS was the political significance of the feudal system, and its military reaction was that wars became trials by battle between factions of the aristocracy in which the common people were excluded and in which, when required to do so, the Church acted as God's referee. Battles were contests of prowess and skill in which killing was secondary to capture for ransom.

Into this political framework, and in medieval times religion was politics, came gunpowder. What was its political significance? It was that it democratized war. Blaise de Monluc (1502-1577), Marshal of France, said of the arquebus that it was "the Devil's in-

General Fuller is a well-known British soldier-author, one of the outstanding military analysts and historians of the present day. He is a frequent contributor to the pages of ORDNANCE.

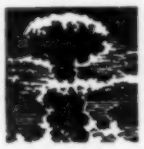
vention to make us murder one another."

Why the Devil's? Cervantes (1547-1616) in "Don Quixote" gives the answer: it is that "the devilish invention of artillery enables a base cowardly hand to take the life of the bravest gentleman. . . A chance bullet, coming nobody knows how or from whence, fired perchance by one that fled affrighted at the very flash of his villainous piece, may in a moment put a period to the vastest designs."

In other words it destroyed the aristocratic order of society and by destroying it changed the entire method of war. This in the days of the Renaissance was considered as devilish as today we consider the destruction of our democratic or bourgeois order by Communism.

IN part, this was appreciated by Condorcet (1743-1794) in his "Esquisses d'un tableau historique des progrès de l'esprit humain," in which he connects the rise of infantry with the rise of democracy, though he would have been more correct had he reversed the sequence, because the musket made the infantryman and the infantryman made the democrat. Gunpowder, as Carlyle says, "made all men tall."

In this brief analysis the point to note is that it took several hundred years in which to gage the political significance of gunpowder. Yet in the fifteenth century, when firearms were gradually being adopted, seeing that they could render armor useless and shatter castles (those two abutments of feudal power) not only were feudal warfare and the feudal social order doomed, but it should have been evident that they would be replaced by bourgeois warfare and the bourgeois social order.



Toward the end of the fifteenth century we find such noted soldiers as the Condottieri Gian Paolo Vitelli and Prospero Colonna stumbling on this, for they declared that wars were won rather by industry and cunning than by the actual clash of arms.

With this background in mind, I will next turn to atomic warfare and more particularly to the hydrogen bomb—the most powerful of all atomic weapons. What is its political significance? I hope that I have made it clear that until this question is answered it is not possible to fathom its repercussions on warfare as waged today; that is, in the late bourgeois age.

Because of its tremendous destructive potential to both friend and foe, the new weapon may prove as great a deterrent to international wars as gunpowder was to the interfeudal wars of an earlier age.

Its political significance does not lie in its destructiveness, which is part of its military nature and which I need not enter upon because it is common knowledge. Instead, so I hold, it is that it is likely to prove as great a deterrent to international wars as gunpowder was to interfeudal wars.

In other words, what gunpowder did to the feudal or aristocratic order, the hydrogen bomb will do to the bourgeois or democratic order.

Again, let us make certain of our premises. What do we actually mean by "international war" from the political point of view? The struggle between organized armed forces which seek to impose the will of their respective governments on their opponent's government by defeating its fighting forces or reducing them to impotence in order that negotiations of peace may be opened and a settlement of the dispute arrived at.

This highly conventional type of war began to break down in 1919 when the First World War was liquidated by an imposed instead of a negotiated peace, and in the Second World War the breakaway was so complete that no peace, either negotiated or imposed, was found possible. Hence the present state of "wardom."

This means that, instead of war being looked upon as a political instrument, peace has taken its place as a war instrument and has become the parade ground of what is called "cold war"—proletarian war.

Next, within this framework let us introduce the hydrogen bomb and examine its political significance and its reactions on the organized international warfare which has prevailed during the bourgeois age.

In the British "Statement of Defence 1954," presented to Parliament in February last, we are told it is visualized that the next war will be opened by a relatively short period of intense atomic attack followed by a period of "broken-backed" warfare—which, incidentally, can only mean complete paralysis.

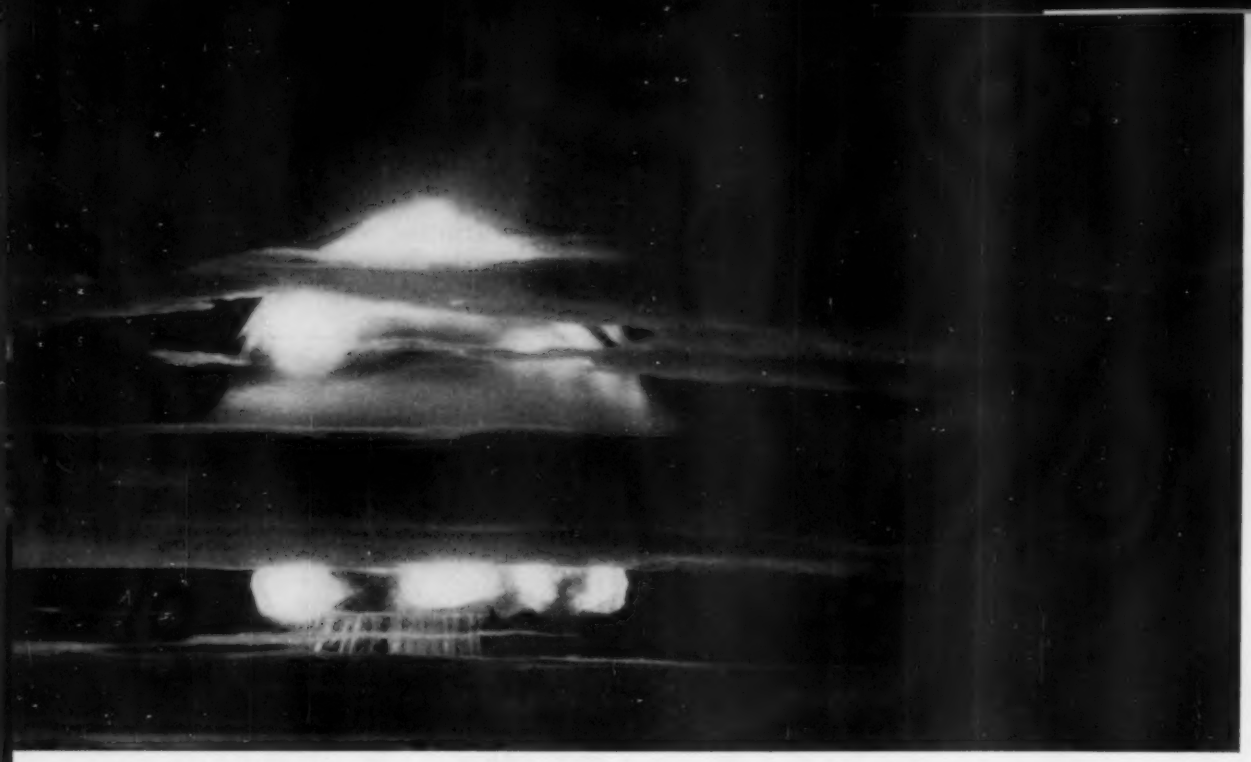
Therefore, British "active forces must be able to withstand the initial shock," and British "reserve forces must be capable of rapid mobilization behind the shield which our active forces provide and be ready to perform their combat tasks at the earliest possible moment."

This is a farrago of nonsense. Not only is the political significance of the atomic attack overlooked but also its military reactions. How are the active forces going to withstand the initial shock, and, if they cannot withstand it, how are the reserves going to mobilize in time to perform their combat tasks?

THOUGH I am no prophet, when I accept what I have read of the hydrogen bomb, and when I accept what the recent history of war points to—namely, that the next war will be undeclared—my prediction is that one hydrogen bomb exploded over London will immediately put the whole of Great Britain *hors de combat.*

Firstly, her government will disappear *en bloc;* and, secondly, the destruction of London will automatically place over half her people on starvation level.

Add to this half a dozen other bombs on Liverpool, Bristol, Glasgow, etc., and one or two on the shield and there will be such chaos that mobilization will be impossible.



Typical cloud formation develops after H-bomb detonation during Operation Ivy conducted in the Marshall Islands (Air Force photo).

Transfer this type of war to the United States and Russia, and though they are less vulnerable than Great Britain is to atomic attack, by multiplying the number of bombs dropped the same results are predictable.

The truth therefore is that the hydrogen bomb has bereft organized international war of its political significance. It has not only made this type of war mutually suicidal but also ridiculous for all it can lead to is universal chaos, and anarchy is the one thing which throughout history has terrified man—he will submit to any form of government in order to avoid it.

The issue is that the hydrogen bomb is a deterrent to a particular type of warfare, exactly as in its day gunpowder was to another particular type.

THIS was recognized before the Russians built their first atomic bomb; for time and again Sir Winston Churchill and others proclaimed that, though the Western Powers had disbanded the greater part of their fighting forces, because they had the atomic bomb the conventional Russian Army—the mightiest in the world—was virtually disarmed.

If this be true, then it logically follows that, now the Russians have the atomic bomb and probably the hydrogen bomb also, instead of the deterrent of conventional warfare having been canceled out, it has been doubled.

An example of this is the recent war in Korea. At any moment it might have been terminated by the atomic bomb, and the reason it was not was fear that the Russians would retaliate, and were they to do so the result would be a third world war.

So powerful was this potential threat that the United Nations were willing to forego their political aim—the unification of Korea—rather than risk a problematical extension of the war.

If this does not clearly reveal the political significance of atomic warfare, then all I can say is that, in this age of adult scientific-mindedness, we must be inflicted with political infantilism.

Does this mean that war is approaching its end? Certainly not, because the fundamental causes of war are profoundly psychological; therefore they cannot be eliminated by physical means. St. James put his finger on this when he wrote: "From whence come wars and fighting among you? Come they not hence, even of your lusts that war in your members?"

War is part and parcel of human nature—original sin. It is Hydra-headed and has many faces.

All it means is that one type of war has become obsolete and that another type is taking its place. As gunpowder democratized war by annulling it as the perquisite of the nobility and handed it over to the middle classes, so are atomic weapons now proletarianizing war by removing it from the hands of the bourgeoisie and placing it into those of the proletariat. This they are accomplishing by rendering gunpowder warfare ridiculous and thereby depriving it of its politcal significance.

FOR want of a better name, the new form of war in this age of mass-man is called "cold war." It is a combination of psychological war, the weapons of which are the emotions of man, and the most primitive type of war, guerrilla war, which throughout history has been the military instrument of the masses.

This has not come about because of Marxist Communism, which is no more than a political effect of industrialization, but by the impact of industry and science on civilization and through civilization on war, in which the moral factor is, more and more, taking first place.

Three-quarters of a century ago an English soldier, Col. C. B. Brackenbury, put his finger on this crucial military change when he wrote in the July 1878 number of *The Nineteenth Century Review*: "Moral effect is the object aimed at in a battle, for the killed and wounded have no influence on the final retirement."

THIS was with reference to his proposal to armor field artillery in order to enable it to face rifle and shrapnel bullets at close ranges.

Moral effect and not physical destruction was the soul of the tank blitzkriegs of the last war the aim of which —even if unrecognized at the time— was not to kill the enemy's soldiers, but to paralyze his command.

In strategic bombing it was also the goal which it was hoped would be achieved, and in atomic warfare it is fear of mass annihilation which is holding it in leash and, as we have seen, even at the cost of foregoing victory.

Finally, in the radio we have the most powerful of all proletarian weapons which without physical or material destruction can subvert man's mind.

What does all this amount to? That industrial civilization has taken panic at its own military creations and out of sheer self-preservation is whispering into the ears of all would-be combatants: "Unless you change your method of fighting, all you fight for will be lost in your final victory or defeat, because physical warfare in atomic terms has ceased to be a profitable instrument."

When we remember that we are now living in a transitional period between two forms of war—one dominantly physical and the other dominantly psychological—how should we proceed?

Firstly, we must secure ourselves against the old form of war—that is, a repetition of the last one—in order that we may be in a position to concentrate all our energies on the new.

Secondly, we must secure ourselves against the new form and, thirdly, wage it to the full, because it is an actual and not a problematical war—a war which is daily being waged by the Kremlin and so far virtually unopposed. Therefore the longer we delay to do so, the more vulnerable we shall become to psychological attack.

To fit the first requirement, atomic weapons are the deterrent, for if I am right in my conjecture that the old, traditional gunpowder wars are rendered unprofitable, if not inoperative, when faced by atomic attack, then it follows that he who holds atomic superiority is the more likely to prevent his opponent indulging in them.

There is, however, a rider to this problem—and an important one. Should a great power, possessing atomic weapons, be in alliance with a number of lesser powers which do not possess them, it can resort to a war by proxy in which, covered by the great power's atomic might, the lesser allied powers can indulge in war on traditional lines.

THIS is the position Russia holds. The whole of her western flank and the greater part of her eastern are girt about by satellite powers of her own political persuasion. As the Korean war—a war by proxy—made clear, because satellite wars are unlikely to lead to atomic wars they will be fought on traditional lines.

As far as Russia's western satellites

Photographed 50 miles from detonation site, the huge atomic cloud is spreading over a distance of 100 miles (Air Force photo).

are concerned, the answer to this rider is to reinstate the German Army on its traditional footing as a deterrent to satellite aggression.

It does not matter to France how powerful the German Army is, for as long as it is not provided with atomic weapons it cannot threaten her or any other country backed by the United States—the greatest atomic power in the world.

And should a day come when the Germans manufacture atomic weapons, their traditional army, whatever may be its size, will become a secondary factor.

As regards the second requirement —security against subversive attack— the present position of the Western powers is one of self-immolation. Their argument is: Because certain methods of psychological warfare contravene the principle of freedom upon which democracy is based, should they be adopted defensively Western nations will cease to be democratic.

THIS is an altogether illogical argument, because the basic principle of any social or political system should be that of self-preservation. For instance, in the case of infectious diseases the freedom of the individual is drastically curtailed by compulsory segregation; and because Russian Communism is for Western democracy as virulent a disease as smallpox is for individuals, if Western democracy is to be safeguarded against it, Communism must be segregated or, better still, eliminated.

General Fuller, a frequent contributor to these pages over many years, is now completing a monumental three-volume historical work, "Decisive Battles of the Western World." The first volume, "From Earliest Times to the Battle of Lepanto," is reviewed in the book section of this issue of ORDNANCE *(page 272).*

Lenin laid it down that: "We must be able to resort to all sorts of strategems, maneuvers, evasions, and subterfuges only so as to get into the trade unions, to remain in them, and to carry Communist work within them at all costs. . . The Communist Party enters such institutions not in order to do constructive work but in order to direct the masses to destroy from within the whole bourgeois state machine and parliament."

This is the most deadly form of proletarian war the Western nations are now faced with, and unless they secure themselves against it by eliminating the defects within their political and social systems, and by securing themselves from Communist contagion, a time may come when they will be incapable of waging war in any form.

Thirdly, as the surest defense is the offensive, the Western nations should turn the tables on their enemy. Actually this is a simple problem, because the U.S.S.R. is a mosaic of subjugated nations, and most of the 100,000,000 people in the Russian occupied countries are violently opposed to Communism.

HERE is a ready-made psychological bomb, which if detonated will blow the Soviet Imperium into its ethnic parts, and freedom is the fuze which will detonate it.

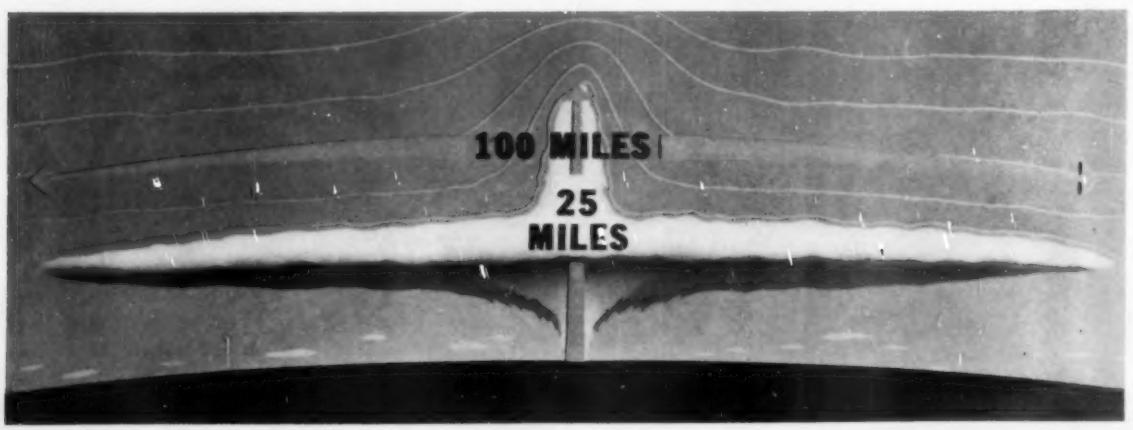
Because freedom is held to be the most sacred of democratic assets, why not then unsheath it and offer it to the subjugated and suppressed peoples as the sword of their liberation, instead of retaining it in its scabbard to be eaten away by Communist rust?

Because one projectile can demolish Moscow, London, or New York, what science has accomplished is to render the military instrument too powerful to attain a profitable political end. It has not abolished war; far from it, it has forced it into a channel in which the physical means of waging war are more and more likely to play a secondary part and increasingly become more primitive.

We are at the parting of the ways in what would appear to be the greatest revolution in human conflict that the world has so far seen.

Though we cannot immediately abandon the old road, unless while we are still traveling along it we also plant a firm foot on the new the high probability is that, equipped though we may be with weapons of the most fantastic powers, we shall be rotted to death by a physically invulnerable pestilence.

Artist's conception of the total height and spread of the cloud developed in the H-bomb explosion (Air Force photo).



Beware of Glamour Weapons!

The aftermath of the historic victory of the Monitor over the Merrimac was an outstanding example of the fallacy of allowing politics to influence judgment about the real effectiveness of weapons

Maj. George Fielding Eliot

IT is certainly tempting to enthusiasts in the armed forces or in industry who have, after infinite labor and innumerable disappointments, finally turned out a brand new weapon to seek some public notice for their triumph. They've worked long and hard to make their dreams come true. They believe they have done a service to the state, and they want people to know about it.

Unhappily, in these wonder-weapon-a-minute days—and these days when the use of a mere spineless superlative like "best" or "revolutionary" is equivalent to a damning with faint praise—public attention is not readily attracted save by loud, raucous, and persistent hollering and the use of expressions ranging upward in emphasis from "supercolossal."

The result of this competition for popular notice is that a public which, fifty years ago, was quite ready to choose up sides and argue heatedly as to whether it was or was not sound judgment to substitute the .45 Colt automatic for the .38 Colt revolver as a sidearm for soldiers in the Philippines, today can only be induced to sit up and take notice by the kind of high-glamour persistent publicity campaign which was recently put on for the 280-mm. atomic cannon.

TO this generally blasé attitude toward man-made miracles on the part of Joe Doakes may be added the fact that Joe's reactions to military affairs in general have a lot to do with the attitude of his Congressmen and Senators and hence with the size and allocation of appropriations for more miracles.

Major Eliot is military and naval correspondent with General Features Syndicate and military analyst for the Mutual Broadcasting System. He is the author of several books including "The Ramparts We Watch" and "Hate, Hope, and High Explosives" and is a frequent contributor to the pages of ORDNANCE.

The net result has been an almost unseemly competition in claims and counterclaims for this weapon and that and, in the larger view, for this or that method of providing for the national security. So far has this gone that there was some danger during the last election of a political choosing up of sides on the validity or otherwise of the late Senator Taft's views on military policy—views which came very near to a Fortress America defensive concept.

When bids are made for public support of military ideas, however well-intentioned the attempt may be, the inevitable result is to involve in the discussion the politicians who are also seeking public support for their own purposes.

Once a politician finds himself—perhaps without fully understanding what is really at stake—publicly committed to supporting a given military viewpoint, he is quite likely to stay with it regardless.

This, of course, is nothing new. Sir Winston Churchill, in his admirable biography of his great ancestor, the Duke of Marlborough, notes how Whig and Tory lined up on military policy in 1701—the Whigs believing in large-scale offensive land operations in Europe intended to drive into the heart of France and force decisive battle on King Louis XIV while the Tories were opposed to the use of British ground troops on the Continent and wanted a maritime war against French commerce and colonies.

These opinions hardened until they became matters of party faith, and Marlborough as allied commander in chief could hardly make a move without taking into account what would be said of it in the House of Commons and its effect on the political fortunes of the government to which he had to look for the support of his operations.

To Marlborough, this was a serious handicap, as it was to the England he served. In this air-atomic-electronic age, however, the results of an unbalanced or misdirected military policy can be rather more than serious.

It is no use saying that balanced judgment will prevail in the end despite the cries of extremists and the claims of partisans in or out of uniform. The sad fact is that balanced judgment is just not glamorous or exciting, and no genius has yet invented an advertising technique to make it so.

Confronted with balanced judgment, say in a TV forum, people yawn and turn the little knob to find something more amusing or, perhaps, more sensational.

What Joe Doakes wants is the fast answer that makes all this military hocus-pocus simple. Of course there aren't any fast answers that are also accurate answers, and there is no way to present a simple explanation of the terrible complexities of military policy in capsule form.

Military men know this well enough; politicians don't always know it—but both sometimes find it hard to resist the temptation to say the acceptable thing or to seek the easy road to public favor for their hopes and ambitions.

ONCE this happens, just as in Marlborough's time, backing up isn't easy. The tendency is to go on and on, until contact with reality is lost and any reasonable questioner of the sacred dogma is charged with being prejudiced, out of date, or narrow-minded—if nothing worse.

In the case of really passionately held doctrines, with which the political fortunes of individuals or parties have become bound up, dissent may even come to be confused with professional incompetence or, in the last analysis, with treason.

Careers of perfectly innocent people whose only fault is insistence on balanced judgment, rather than blind worship at the new altar, can be ruined by opposing or even by failing in enthusiasm for a doctrine or a gadget cherished by those in places of power. This has occurred in our history long before the atomic age imposed its grim sanctions upon distorted military thinking.

Perhaps an extended examination of one such instance may be helpful.

On March 9, 1862, a most peculiar-looking warship named the U.S.S. MONITOR arrived in Hampton Roads, Va., barely in time to prevent the total destruction of the Union blockading squadron by the Confederate ironclad VIRGINIA (originally the MERRIMAC).

Thereby, unquestionably, the Union cause was saved from a disastrous defeat—perhaps from final and irreparable disaster, for the blockade of the South was an essential ingredient of the subsequent Union victory, and the blockade had to be maintained chiefly by wooden ships then and thereafter.

The most acute anxiety had been aroused throughout the North by the successes of the VIRGINIA on the previous day when two blockading ships had been destroyed by a foe which seemed to be invulnerable behind its iron carapace. The sigh of relief which followed the news of the MONITOR's success resounded from Maine to Kansas. Never had a new weapon gotten off to so good a start from the public-relations viewpoint.

That the MONITOR was a new weapon was beyond question. She had not a vestige of a mast or a sail. She was proudly claimed by the Engineer Corps of the Navy (at that time a separate branch and fighting hard for acceptance and recognition by the line officers) as an "engineer's ship."

Everything in connection with the repair and maintenance of hull, armor, and turret was an engineer responsibility, and an engineer officer had to be in the turret to operate the lever of the donkey engine which turned it.

After the defeat of the VIRGINIA, attempts were even made—notably by John Ericsson, the talented designer of the MONITOR—to minimize the credit due to her commander, Lieutenant Worden, and to claim the principal kudos for Chief Engineer Alban C. Stimers, who had superintended her construction and was on board as a volunteer during the engagement, on the ground that "Stimers alone of all on board thoroughly understood and knew how to operate the various mechanisms."

The rebound from despair to exultation had a marked effect within the Navy Department, especially on its two civilian chiefs, Secretary Welles and Assistant Secretary Fox, the latter a former naval officer. Fox, who had witnessed the fight from Fort Monroe and who up to that time had entertained some doubts about "Ericsson's cheese-box-on-a-raft," was like a man who has seen a miracle with his own eyes.

With the zeal peculiar to all converts, Mr. Fox fell to planning how this invincible new weapon could be used to gain even greater successes. In his mind rankled his failure to relieve Fort Sumter the year before. To him, as to Welles and to many others, Charleston was the cradle of the rebellion. To punish Charleston would have an electric effect on the then gloomy fortunes of the Union.

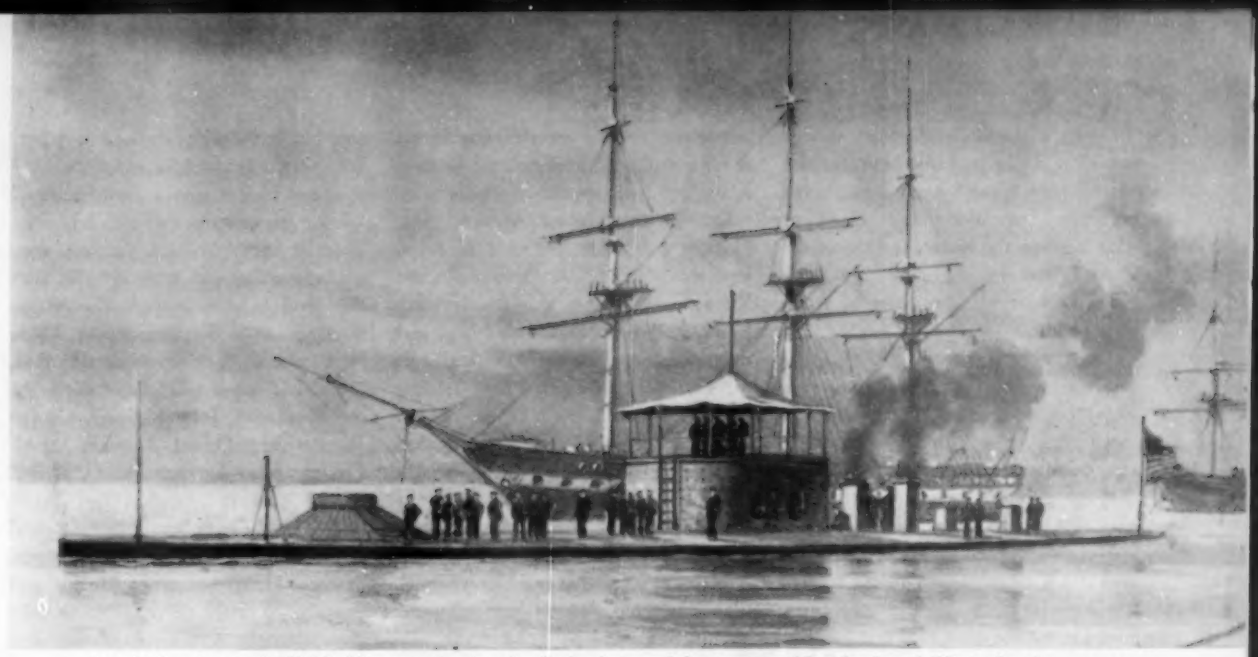
And now the means were at hand: Build new monitors, storm into Charleston Harbor past forts which would be helpless to pierce the armor of these avengers, and compel the proud, rebellious city to surrender at the mouths of their cannon.

That was the plan. No doubt of success was entertained by its authors. Did they not have the perfect weapon?

Doubts, however, arose at once in the mind of the veteran officer to whom this enterprise was to be entrusted. Rear Adm. Samuel F. DuPont was then the commander of the South Atlantic Blockading Squadron. He had been in the Navy forty-six years and had a high professional reputation which had been considerably enhanced by his successful reduction (with wooden ships) of the Confederate fortifications at Port Royal, S. C., in order to obtain possession of that harbor as a base for his squadron and by his subsequent establishment of control over most of the coast line of South Carolina, Georgia, and Florida—the only two points still in Confederate hands on those shores being Charleston and Savannah.

DUPONT was certainly "Old Navy," but he was very far from being "old fogy." He had a clear and alert mind with which he readily perceived the difficulties in the way of storming Charleston from the sea by naval forces alone.

"This," said DuPont, "is no business of running past forts in the darkness and, being past, having everything at your mercy like Farragut at New Orleans. Charleston Harbor is ringed with batteries. The ship channels con-



An old drawing of the U.S.S. MONITOR showing the distinctive revolving turret and low freeboard (Navy photo).

verge at the entrance under the converging fire of Fort Sumter and the forts on Sullivan's Island.

"Once past that, my ships will come under a second series of converging fires from Castle Pinckney, Fort Ripley, and Fort Johnson. Overcome these, and the inner batteries still remain as a third hazard. There are also rope and pile obstructions in all the channels which are designed to hold ships under the fire of the forts, and I have reason to think that these obstructions include torpedoes.

"Finally, it is a principle of such operations that they should not be conducted by naval forces alone—troops are necessary to insure success, otherwise naval gains cannot be permanent even if achieved. It was so at Port Royal, and it was so at New Orleans."

"But you'll have *monitors,*" cried Fox. "Monitors are impregnable—invincible. Why, the mere appearance of a single monitor will cause Charleston to capitulate in a hurry."

DuPont said he'd try.

They sent him monitors—seven of them, somewhat larger than the original and more heavily armed. Instead of two 11-inch guns, these had one 15-inch and one 11-inch side by side; they were designed for two 15-inch, but the bigger guns couldn't be turned out fast enough, and Messrs. Welles and Fox were in a hurry.

The guns were smoothbore Dahlgren muzzle-loaders. The process of sponging and loading inside the cramped turret required the use of rammers with staffs made in sections, one section after another being attached as the charge and projectile were pushed along the bore. Since the weight of the 15-inch shell was 352 pounds, this clumsy method of loading did not conduce to rapid fire.

DuPont used Fort McAllister, a Confederate earthwork defending the Ogeechee River near Savannah, as a trial target, first with one monitor, then with three together. Result: no damage to the fort "that couldn't be repaired in a good night's work," as the senior captain, Percival Drayton, put it. Not much damage to the monitors either.

But, as DuPont wrote to the Department, "Whatever degree of impenetrability they might have, there was no corresponding quality of aggression or destructiveness as against forts, the slowness of fire giving full time for the gunners in the fort to take shelter in the bombproofs."

In a contest with forts, DuPont seems to have reached the conclusion that the monitors might be able to take it but couldn't dish it out. However, he thought well of their qualities in general and especially of the future prospects of the type after the "bugs" had been eliminated by experiment with this first batch.

To Fox he wrote privately: "I think these monitors are wonderful conceptions, but oh, the errors of detail which would have been corrected if these men of genius could be induced to pay attention to the people who are to use their tools and inventions."

For Mr. Ericsson would not hear of any criticism or suggestions from sea officers, and the engineers associated with him, headed by Stimers, were equally touchy about their miracle weapon. The merest hint of any defect, and the cry of "Old-Navy prejudice" was instantly raised.

Commander Downes of the NAHANT, acting under the order requiring all monitor captains to make reports and suggestions to the Bureau of Ordnance, had the temerity to point out that the decks of the monitors were their weakest points as shown in the attack on Fort McAllister.

"Ignorance and prejudice," stormed Ericsson. "Monitors aren't supposed to fight broadside on, thus exposing their decks to fire when the ship rolls. They should fight bow on, always."

Gently Commander Downes replied that since shells fired from any distance beyond point-blank range have a curved trajectory "by laying the length of your deck to the enemy instead of the breadth, you are the more completely exposing your weakest point of resistance to him."

The trouble was that the distinguished inventor and his engineers insisted on looking at the monitors as mechanical devices and not as ships; no considerations relating to seamanship or gunnery weighed with them very much.

Welles kept pressing DuPont to hurry and attack Charleston. DuPont wanted a margin of force—more monitors. He got the NEW IRONSIDES, a huge armored broadside frigate, and an ironclad ship with fixed towers instead of turrets named KEOKUK. These, with his seven monitors, were all the armored ships that were available. It had taken many months to assemble this many.

Welles, meanwhile, was under severe pressure, due in large part to the wildly exaggerated claims about what the monitors were going to do to the Charleston forts that had "leaked" from various sources into the press.

THESE reports not only urged forward the Southern defensive preparations, but they were the subject of sharp criticism from Senator Hale of New Hampshire, chairman of the Naval Affairs Committee of the Senate. Hale had little faith in the monitors as a class and said so very bitingly. Now Welles was frantic for a great success at Charleston.

To deal with the obstructions, Mr. Ericsson designed a special raft, fitted with grapnels and with a "submarine torpedo" which was intended to explode 400 pounds of powder in a forward direction to blow up the obstructions and detonate the mines (then called torpedoes). This raft was supposed to be pushed ahead of a monitor; it was shaped like a bootjack, with a V-shaped indentation in its stern into which the bow of the monitor was supposed to fit.

Three rafts were sent down in tow of a steamer; two broke away and were lost at sea, but one was delivered intact at Charleston. Chief Engineer Stimers arrived to lend his aid and advice.

On the afternoon of April 7, 1863, DuPont was ready. He took his seven monitors, plus NEW IRONSIDES and KEOKUK, into the channel between Fort Sumter and Sullivan's Island and slugged it out with the forts until five o'clock. WEEHAWKEN, the leading monitor, pushed Mr. Ericsson's raft ahead of her with grapnels attached but minus the torpedo—John Rodgers, her captain, considering "that folly would rise into crime which should carry loaded torpedoes in a rapid tideway in a somewhat narrow channel, without known buoys, under fire, with the attention distracted, and among a friendly fleet."

At any rate, the monitors all avoided entanglement among the rope obstructions. Considering the terrific storm of fire to which they were subjected, this seems the part of prudence. All the ships came out again safely when evening approached.

But they were not in the same condition as when they went in. KEOKUK was so riddled that she sank at her anchorage. Five of the seven monitors were wholly or partially disabled. Stimers pooh-poohed the damage, said it could all be repaired in a few hours. But some of the monitors were still undergoing repair a month later.

DuPont listened to the reports of his captains with dismay. He had announced his intention of renewing the attack in the morning. But when morning came he thought better of it.

He told his chief of staff, Comdr. C. R. P. Rodgers:

"I have decided not to renew the attack. Five monitors are seriously damaged by a comparatively brief engagement. We have only encountered the outer line of defense; if we do force our way into the harbor we have not men to occupy any forts we may take, and we can have no communication with our force outside except by again running the gauntlet. In the end we shall be forced to retire, leaving some of our ironclads in the hands of the enemy to be refitted and turned against our blockade with deplorable effect. We have met with a sad repulse; I shall not turn it into a great disaster."

Later his captains came aboad again. Told of the Admiral's decision, they one and all agreed with it fully, both then and in their written reports for transmission to the Department. These were picked men—Percival Drayton, John L. Worden (skipper of the original MONITOR), John Rodgers, George W. Rodgers, Daniel Ammen, D. M. Fairfax, John Downes, A. C. Rhind.

"IT would have been difficult to find in the Navy," says C. R. P. Rodgers, "men of higher reputation for skill and courage, of better nerve, or more fully possessing the confidence of the service. . . . Their opinion . . . came from men of recognized judgment and experience, and they never flinched from it in later days when they might have won favor in high places had they wavered in their disinterested allegiance to their old leader."

For the storm of disappointment, official and popular, broke upon DuPont with cruel violence.

"The Nation is disgraced!" screamed the press. DuPont was afraid of torpedoes. He had the Ericsson rafts and would not use them. And so on.

To these attacks, the Department left their Admiral exposed without any attempt to make reply. Mr. Welles even refused to publish DuPont's official report and those of his captains, replying to DuPont's protest with the significant observation that because failure was largely imputed to the defects of the monitors "it has not appeared necessary to your justification that the powers of assault or resistance of these ironclad vessels should be depreciated, and I regret that there has been any labored effort to that purpose . . . The country is, I conceive, better served by omitting for the present their publication."

DuPont was relieved of his command early in July, being replaced by Rear Adm. John A. Dahlgren. He was not again given active employment during the war. But he continued to be the subject of bitter attack by the monitor clique, the spirit of which is well sum-

marized by the remarks of Chief Engineer Stimers as to what he calls Admiral DuPont's attempt "to justify his inaction and failure by attacking that system of war vessels . . . which might have transmitted his name with honor far into the future. *An assault upon that system can but recoil upon the assailant.*"

There speaks the voice of the true zealot.

Yet events proved DuPont to have been entirely right. His successor, Admiral Dahlgren, like DuPont, insisted on the coöperation of troops in any naval assaults on Charleston. Luckier than DuPont, he got what he wanted.

But even so, the nut was never cracked from seaward. Not until Sherman's army came up from Savannah was Charleston taken, though Dahlgren and General Gillmore tried their hardest for two weary years. No ship of the Navy (until the final surrender) entered the harbor of Charleston, even after Sumter was in ruins, its fire silenced, and the batteries on Morris Island in Union hands.

Dahlgren's judgment concurred with DuPont's: Charleston could not be taken from the sea. The Navy Department refused to publish Dahlgren's report to this effect, because Dahlgren in his own justification made reference to the previous opinion of DuPont and his captains. "The Department was too inimical and revengeful toward DuPont," says Dahlgren's biographer (his wife), "to be just or to be willing to have him relieved in any measure, through any act of theirs, of any possible effect of their continued displeasure."

HE had spoken against the sacred monitor. He had said it could not do everything. He was cast into outer darkness, as befitted such sacrilege—especially when it might get his boss into a jam.

Thus was sacrificed an officer of great distinction and high professional attainments, beloved by all who served with him and capable of giving much useful service to his country.

The monitors, for the remainder of the war, proved valuable precisely for the service for which the original

"That policy is charged with peril which stubbornly insists, despite repeated warnings, that strategy must conform to any preconception to which eminent gentlemen have become publicly committed—whether that conception be that a fortified harbor can be stormed from the sea by the wonderful monitors or that the United States can worry along without continental air defense because we can keep our foes indefinitely intimidated with the wonderful A-bomb."

MONITOR was built, and nothing else: fighting Confederate casemate ironclads in smooth water. At that they were indeed invincible. For fighting forts, they were of little or no value. At sea, they were useless.

Yet the central idea of the monitor, the germ provided by Ericsson's genius, was the armament of heavy guns in revolving turrets. From this germ developed the high-freeboard, seagoing battleships which were to dominate the seas of the world for sixty years.

All that was needed was to combine the Ericsson turret with the ideas of the seaman and the gunnery expert as to how to take it to sea and fight with it when there. Every major foreign navy seized upon this concept and began putting it into practice at once. But not the United States Navy.

In the United States Navy the original devotees of the monitor cult had to be proved right—to put their precious turrets into seagoing hulls would have been a tacit acknowledgment of the need for engineers and their political backers "to pay attention to the people who are going to use their tools and inventions."

Thus there arose the pernicious idea of a "coast-defense Navy" with which we had been plagued once before in Thomas Jefferson's day, also largely because of mistaken ideas which had become politically enshrined.

So the low-freeboard monitor had to be defended; and since common sense revolted at the idea of fighting open-ocean battles with it, for thirty years after the Civil War the idea of "coast-defense ships" poisoned our naval development.

As late as Theodore Roosevelt's time it was necessary for the Navy Department to appease this "coast-defense" sentiment by describing the new battleships of the GEORGIA class (then the most powerful ocean-going warships yet designed) as "first-class coast-line battleships."

THE peril in all this was not only the political entrenchment of an erroneous concept of naval warfare, but the loss of thirty precious years in the development of sea-going armored ships. We were fortunate indeed that in 1898 we had an antagonist whose fleet was in as poor a condition as was Spain's.

Today, the consequences of such loss of time would be far more dire than the failure before Charleston and the subsequent loss of the blood that was spilt in trying to bull it through afterward; far more dire even than a naval defeat by Germany in 1898 might have been.

The lesson to be learned is surely that the design and characteristics of weapons are not suitable subjects for political debate. True, it is for the political leaders who represent the electorate to determine policy. Policy inevitably controls strategy, and policy must take into account strategic limitations and capabilities.

But that policy is charged with peril which stubbornly insists, despite repeated warnings, that strategy must conform to any preconception to which eminent gentlemen have become publicly committed—whether that conception be that a fortified harbor can be stormed from the sea by the wonderful monitors or that the United States can worry along without continental air defense because we can keep our foes indefinitely intimidated with the wonderful A-bomb.

For political leaders to tell their uniformed advisers—or their scientific advisers—that they must conform—or else—was dangerous enough in years gone by. Today the result can be national extinction without hope of recovery.

The M59 "Miracle"

The new track-laying armored personnel carrier promises to revolutionize infantry tactics with its ability to move troops safely, quietly, and quickly across land and water

Garrett Underhill

THE Army-Industry Team, all on its own, apparently has wrought a virtual miracle which bids fair to revolutionize land warfare in the atomic age.

Equally remarkable is the fact that this "miracle"—the M59 track-laying armored personnel carrier—is being built at 2 1/3 times less cost than had appeared possible before Korea gave the Army-Industry Team actual experience in producing and using this type of matériel.

Too often in the past the Army has signaled the introduction of a new item with a press fanfare which gave the new weapon a paper reputation difficult, if not impossible, to maintain in practice. In this case the Army has been properly cautious about making claims about the potentials of what it and industry have wrought.

However, production versions of the new item now have undergone troop tests in the Spearhead and Flash Burn exercises last May, following extensive tests of the prototypes. A whole year ago, at Porkchop Hill in Korea, the far less versatile preliminary version of the M59 "miracle" more than proved itself in actual combat.

As a result, it seems in order to override the Army's commendable professional caution and state outright that the Army's new M59 caterpillar-tracked armored personnel carrier promises to:

1. Make conventional warfare almost incredibly safe for the infantry.

2. Provide the protection in motion which all kinds of troops need for maneuver in this age of atomic weapons and guerrilla tactics.

3. Provide the cross-country mobility with long-range control which troops need to effect rapid shifts from wide dispersion to quick grouping for attacks (which quickness leaves little or no time for enemy use of atomic weapons before APC-borne troops are at grips with enemy troops).

4. Provide the means to cross inland waters on a broad front, without preparation of fords or bridgeheads, which means that river lines no longer are barriers at which our troops can be forced to mass to secure bridgeheads and therefore become atomic targets.

5. Provide an amazing degree of comfort on the march, assuring that troops go into action far less fatigued than they ever did when they marched by truck and shank's mare.

6. Provide an entirely new way of worrying enemy commanders as to where our vital reserves are and whether we have committed them.

Actually, the M59 is a "man-carrying tank." It's an armored box using the same caterpillar tracks and suspension as the 25-ton M41 Walker Bulldog tank.

Mr. Underhill served with Army Intelligence during the Second World War and was recalled during the Korean emergency. He is a recognized authority on military weapons.

The inside compartment is designed to carry a squad of ten infantry riflemen, the majority facing each other as they sit on jump seats along the sides. The squad leader sits alongside the vehicle driver in front, and can man a caliber .50 machine gun mounted outside the hatch over his head.

There are two big escape hatches over the main compartment, but normally troops get in and out through the rear end. The whole back of the inside compartment is hinged at the bottom. It swings out and down to form a ramp, with only a slight rise from the ground end to the compartment floor.

THIS access affords a big contrast to the high lift needed to get men and things in and out of a truck cargo body. It means that loading and unloading are easy and fast, a squad needing only two to three seconds to dismount (including time to lower the door-ramp).

The low-slope ramp feature and the unobstructed boxlike interior mean that the M59 can serve many varied uses.

With seats folded down it can carry many types of cargoes or six wounded on stretchers. With door-ramp secured, it offers fine blacked-out facilities for a completely mobile command post, an artillery fire direction center (room is ample for the plotting boards and maps), or as a protected signal repair workshop.

Because the M59 mounts a caliber .50 machine gun formidable against both personnel and unarmored targets,

it can itself serve as a tank. An armored cupola-type turret for the gunner can be provided, but U.S. authorities haven't thought the 1,000-pound weight penalty worth the cargo-load loss, considering the purpose for which the M59's are now intended.

Obviously the M59 can be adapted to mount recoilless rifles (good for antitank use). It can also be adapted to carry mortar squads, who can fire their weapon from the M59 without dismounting.

Being a remarkably "quiet runner," the M59 is fine for reconnaissance purposes. It can tow medium (155-mm. howitzer) field artillery, too. Doubtless, ingenious Americans will figure out still more and perhaps equally valuable uses.

The layman rightly may wonder why this type of vehicle wasn't built long before Korea.

The answer is that the idea for it was tried out almost as soon as the tank. The British armored army of 1919 was, in fact, to have full mechanization: cannon-carrying tanks, machine-gun-carrying tanks, and men-carrying tanks. Some of the latter actually were built in Britain and America before the World War I Armistice.

But for World War II the Germans, then the Americans, provided only semi- or half-tracked armored troop carriers, with open tops.

Open tops then found much favor because they enabled troops to use their personal weapons while mounted. With the advent of atomic weapons, protection factors began strongly to outweigh firepower ones in the minds of many. Now Korean combat experience, backed up by field tests and impressive demonstrations, seems firmly to have established the worth of such cover, even in conventional-type fighting.

WITH overhead cover, troop carriers can now do in attacks what tanks long have been able to do—drive right into the enemy positions while the defenders still are held down in their foxholes by the hail of fragments from the air-burst high-explosive shells with which supporting artillery is deluging the enemy defenses.

The shell fragments merely rattle off the armored roofs of the M59's. There is little danger of a direct hit from a mistimed shell, for the friendly artillery selects a trajectory giving its shells a ground impact well ahead of the M59's and tanks in case the air-burst fuzing occasionally fails.

Informed by radio when the last shells are "on the way," the infantry is ready to pour out in seconds after the last friendly shell bursts.

Thus no longer does the infantry have to assault on foot through the organized patterns of enemy defensive fires, well after the supporting artillery has lifted its fire. Now infantry makes the assault in protected comfort. Individual combat commences only with the mop-up phase, as the troops dismount within the enemy positions.

Moreover, infantry now can assault not at the 2-mile-an-hour infantry foot face but at mechanized speeds. More and more authorities are coming to recognize that even in conventional warfare such mobility in itself is excellent protection. Infinite possibilities open up for surprise maneuvers, too.

And such fleeting targets as M59's are hard to hit. Daring enemy bazookamen are almost sure to get ripped by shell fragments if they stick their heads up to fire. And any enemy weapons crews with overhead protection invite instant retaliation from the herds of cannon-carrying tanks should they dare a shot against the M59's; that is, if they haven't already been neutralized by impact artillery and preparatory tank fires searching every likely emplacement location as the assaulting tank and M59 teams advance.

It seems as if the machine gun's ability to cause positional stalemate, established back in 1915, at last may well have been largely broken. No longer need Americans think of land warfare in terms of continual infantry casualties and suffering!

True, there still will be some areas difficult or impossible for the M59's to negotiate. But, as Russian authorities have been at pains to point out, military minds are constantly at work improving cross-country vehicles.

Of this improvement the M59 is a remarkable example. It will handle more difficult soil conditions than any extant known vehicle, except perhaps a Russian T-34 tank. It will negotiate mud better than a turtle. Swamps are no obstacle, either. Being better balanced and more stable than the earlier and similar-looking M75, it can do even better in rough country than that armored personnel carrier.

AS for the M75's mobility, in Korea M75 APC's kept the Porkchop Hill outpost reënforced and supplied during the Red Chinese drive to take it in early July 1953. The M75's did so, although they had to carry on over a rutted road and steep approach which six days of rain had made a mire of mud. That rain and 70,000 rounds of Red Chinese shell had combined to make the hill itself a "mound of mud and debris."

It was during this Porkchop affair that the boxlike type of new "man-carrying tank" aptly was dubbed "Life-saver" by Ordnance's Brig. Gen. C. H. Deitrick.

At Porkchop, the Chinese Reds' initial attack seized the hill crest, making the position of the outnumbered U.S. force appear untenable. But Maj. Gen. Arthur Trudeau, an Armor man then in command of the 7th Infantry Division, threw away the book and told his small outpost to hold.

Although Red Chinese mortar, artillery, and machine-gun fire rendered the approaches to Porkchop impassable either to trucks or men, General Trudeau used M75's to keep his outpost supplied, to evacuate the wounded, and to rotate manpower in the bunkers, so that Porkchop always was manned with fresh riflemen.

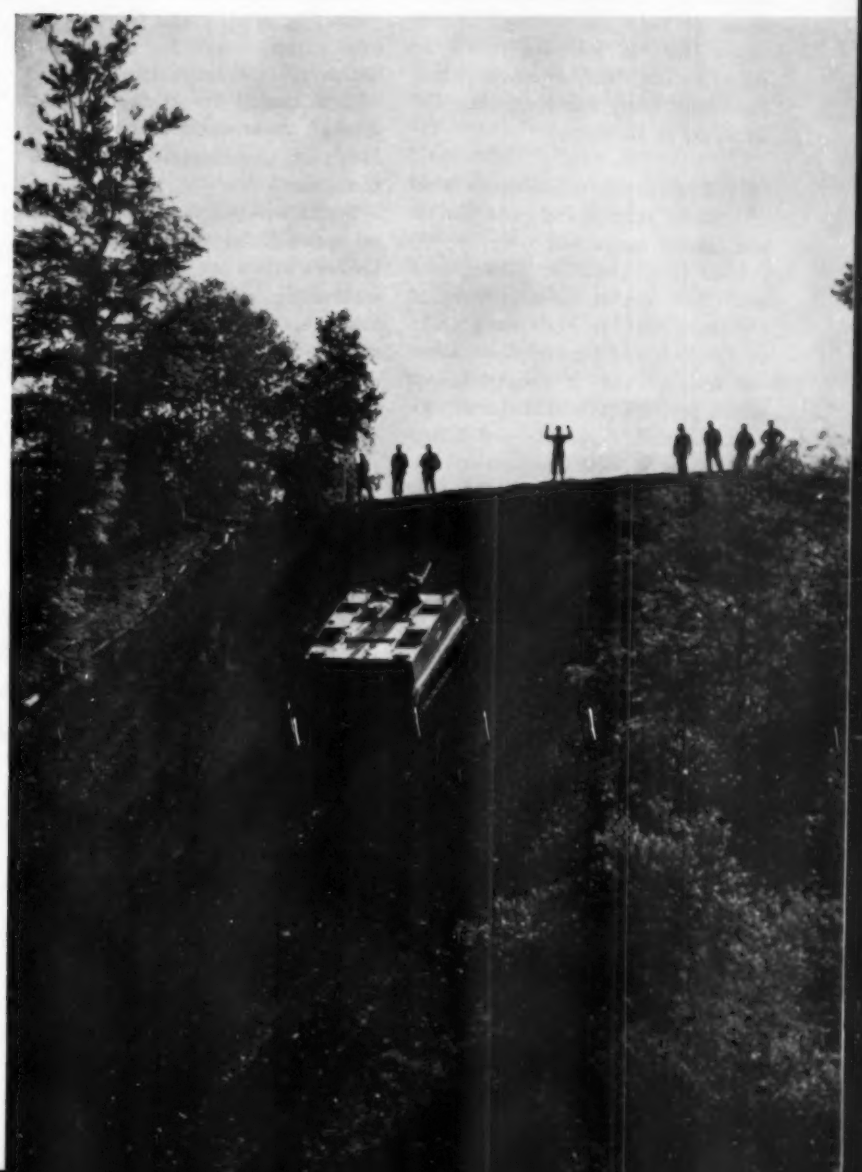
When the position had served its usefulness, General Trudeau not only got his men out safely but sent up engineers in the M75's to blow up the abandoned bunkers so the Chinese couldn't use them.

There are those who think that it may well have been General Trudeau's revolutionary use of APC's on Porkchop which induced the Reds to conclude the Korean truce after two years

At left, usually utilized to transport men, the M59 can also serve to carry jeeps, ammunition, weapons, and equipment rapidly and safely to the front.

Right, safely transported to the battle line, troops pour from the M59. Below, the combat squad spreads out from the armored personnel carrier into battle position (photo courtesy *Armor* magazine).

The M59, above, demonstrates its ability to navigate through water. The plate in front drops down to break waves which might otherwise wash over and swamp the vehicle.



At right, the M59 negotiates a 60 per cent grade during recent field tests held at Aberdeen Proving Ground.

of talks. The Reds knew (if we did not) that the North Koreans and Red Chinese were completely unable to deal with such mechanized war.

Besides, the Red command had been thrown into a tizzy at Porkchop by an unexpected combat asset of the fully enclosed APC's: *the Reds couldn't tell, when APC's advanced or maneuvered in reserve, if they were loaded with U.S. reënforcements or troops for an attack, or if they were carrying ammunition or were empty and bluffing.*

Apparently this "Trojan-horse" feature of the new APC's provides a foxy way to offset Red manpower masses moving on foot. For whereas the Reds can puzzle us by their ability to hide when not moving, General Trudeau's exploitation of the "Trojan-horse" feature shows how we now can puzzle an enemy by our ability to conceal where our troops really are, even when our forces are in motion.

THE M59, with its remarkable cross-country abilities and protection, is just fine for atomic war.

Maj. Gen. Leslie E. Simon, who wears two hats as Assistant Chief of Ordnance and as Ordnance's Chief of Research and Development, points out that the half- to one-inch armor which provides protection against conventional shall fragments and bullets provides good protection against most atomic weapons' radiation and blast effects. It provides complete protection against searing heat flash.

It's true, of course, that a deep foxhole affords virtually the same protection. But the authorities and books and experience tell us that war is won by fire and movement, and unfortunately foxholes aren't maneuverable. If the standard infantry divisions are to maneuver and attack, they can only maneuver by truck or shank's mare and attack on foot.

In such "naked" state, they are highly vulnerable to all types of atomic weapons, as well as to artillery, mortars, and machine guns. Truly, as General Simon puts it: "Naked men are at an awful disadvantage on the modern battlefield."

And even if the men are dug in, their truck transport remains highly vulnerable. Bombs which might leave dug-in troops unscathed could rob them of their trucks and the precious mobility which Korea showed to be America's major advantage against Communist hordes.

While the ABC's of atomic land warfare have yet to be propounded, authorities nevertheless agree that ordinary infantry and supporting troops must be able to vary quickly from formations dispersed over a broad area to groupments rapidly able to come to grips with the enemy and overwhelm him. They must be able to maintain the complex and long-range communications which such warfare needs.

For this, says General Simon, ordinary infantry won't do: "Feet aren't fast enough; ears aren't sharp enough." What's needed is an agile, "landworthy" cross-country vehicle, able to carry the needed radio communications gear.

Trucks won't do, even if they could be armored. As Lieut. Col. M. G. Bekker's study on off-road mobility conclusively establishes (ORDNANCE, March-April 1954), the wheel in its present state lacks the necessary soil flotation.

The M59 caterpillar is needed, as it is undaunted by ploughed fields and snow and mud and swamp. With its armor, the M59 is the soldier's "mobile mechanized foxhole."

The M59-type is needed, too, even as a rear area transport.

Red military doctrine and practice goes in for deep infiltration and guerrilla work by which the Reds hope to incommode their opponents' supply, maneuver, and reënforcement by ambushes and roadblocks.

Indo-China fighting was loaded with examples of this work, and a bigger war might well see use of Red parachute troops for the same job; it's one of their stated missions as the Reds' manuals tell us.

What can happen to trucked troops when the Reds try such tricks was tragically demonstrated in Korea when the 2nd Infantry Division tried to withdraw in the face of Chinese frontal pressure and ran into an ambush. Brig. Gen. S. L. A. Marshall, in his great book, "The River and the Gauntlet," writes:

"A few bullets through a radiator, gas tank, or the rubber usually meant a car down, a group of infantrymen stranded, and the need for another ditching operation, if the column was to get by."

The division consequently was virtually massacred in the Gauntlet, although significantly the tracked vehicles (especially the armored ones) made it and helped others out.

WHILE the M59 furnishes protection against such traps, it's also designed to have cross-country capability rendering the laying of such traps highly impractical. James Hait, the Food Machinery Corporation's director of engineering and manager of its ordnance division which designed the M59, well knew that in these days of air power and enemy ambush, troops ought not to have to ride in roadbound trucks or even in tracked vehicles which have to stick to roads for efficient march movement. That way the enemy knows where to expect U.S. troop movement and can lay cunning plans accordingly.

Now that U.S. troops have the M59 upcoming, they had best sweep from their minds old ideas of vehicular "landworthiness." They must start thinking in terms of "cross-country cruising," as if Army formations were land fleets, similar in movement and tactics to sea and air ones. That's the way to foil enemy plots and develop the superior maneuver potential which our commercial automotive primacy should afford us.

This new "landworthiness" quality in the M59 is actually a result of just what Colonel Bekker's study in ORDNANCE called for: the application to land locomotion of the same type of load-analysis approach long since applied in air and naval engineering.

Because of long experience in the development of America's unique surf-riding "Landing Vehicle, Tracked," series and the construction of 13,000-

The M59 safely crosses a gully which would have stopped earlier vehicles.

odd LVT's since 1940, Mr. Hait and his staff at Food Machinery Corporation were easily able to supply the naval-architecture approach.

As a result the M59, while looking outwardly identical to the M75, is smoother riding across country and negotiates softer and more difficult terrain than any extant U.S. vehicle.

And thus it is that the Army-Industry Team *produced almost simultaneously both the theory to indicate the whole new vista of cross-country vehicle development and the first practical example of how that theory can work wonders.*

NOT the least of these wonders is the demonstration of the fact that such a vehicle, if properly proportioned and its weight distributed for good flotation on soil, *also floats in water, when fully loaded, although it is well armored.*

Think what this does to warfare. Gen. Omar N. Bradley, the 1949-1953 Chairman of the Joint Chiefs of Staff, often has related how the West hopes to capitalize upon its atomic weapons' advantage by defending river lines in Europe and thereby forcing any attacking enemy forces to mass to make a bridgehead, at which point they'll offer good atomic targets.

Now the M59 makes it possible for infantry to make sudden and surprise crossings on a broad front, without previous preparation. The M59 will carry the heavy weapons, too. How it could get the towed artillery support across is left to the imagination and ingenuity for which the average American engineer and soldier is rightly famed. Jeeps can be ferried on the roof.

Since the M59 floats and swims without special devices, its ability to negotiate rough water and river currents is regarded with caution in several quarters. Nevertheless many who have driven it back it to the hilt, while conceding it to be an inland-waterway vehicle and not a "surf-rider."

Now that we know that fatigue breeds fear and fear breeds fatigue (in a vicious spiral of troop efficiency deflation), not the least of the M59's advantages is its comfort.

Veterans of World Wars I, II, and Korea who remember the exhaustion that comes from long and rough truck rides, with men packed like sardines in the cargo bodies, will appreciate the smooth, vibrationless, noiseless, almost dustless "luxury jaunt" the M59 affords. Wounded especially will appreciate not being jounced over ruts and choked with dust.

The apparent miracle the Army-Industry Team has wrought with the M59, poses four big questions for economy-minded defense authorities.

The first question results from the fact that the M59, besides being in many ways better than all known personnel carriers and the similar-looking M75, costs 2 1/3 times less than the M75. The question then is: *Now that such relatively cheap and well-protected transport vehicles are available, can America rightly deny them to those who must man the varied types of troop units able to use them?*

RIGHT now, only three American divisions are to be well-equipped with APC's. These are the armored divisions. Except for some scattered pools of APC's, the Army's twelve infantry divisions, plus eighteen regimental combat teams, will still ride or be towed by vulnerable, roadbound trucks.

That's a mode of transport the Germans decided to abandon for infantry in 1942 when they converted their truck-borne infantry to the armored-carrier-borne *Panzergrenadiers.* And in those days the Russians didn't have tactical atomic bombs.

The second question derives from a big lesson of the M59's development. That lesson proves that General Simon and other military authorities have been dead right when they have warned that *we can only make notable progress by actually building equipment.*

It is General Simon's contention that man is incapable of thinking things out completely in the abstract. Usually he has to see and feel and do things before he really can get remarkable development, along the lines of the adage: "Practice makes perfect."

By the general's thesis there properly should be four stages in the development and issue of weapons and equipment:

1. *Research,* which is science figuring basic theories of technology.

2. *Development,* which is the engineering application. It includes completion of the approved model as an Army-wide standard, after proving-ground tests and (when there's time) troop tests with a small service-test order.

Up to now, full-scale production has been undertaken on the basis of such research and development. However, we now know that this amount of "R&D" can't guarantee the development of an item's full potentials, and so we must have:

3. *Major production on a scale sufficient to give full-scale "production practice" to the Industry-Ordnance Team and to give troops enough items for major field exercises.* As a result of such practical experience industry, the field forces, and Ordnance see all kinds of things which can be done to improve warlike qualities, cut costs and production time, and ease maintenance. Moreover this extensive practical experience enables people to find simple, cheap, and practical solutions to problems which tend to get solved by "Rube Goldberg" methods under more theoretical conditions.

Previously it was often difficult or impossible to make radical improvements of this nature, since new items often went into Army-wide production at once. In the evolution of the M59, the M75 "APC" represented this third stage.

4. *The "better, simpler, cheaper" stage,* as illustrated by the M59. (Ordnance, by the way, has also improved and cheapened the M75.) In this fourth stage things can be done fast, too. Food Machinery had the idea roughed out in July 1951, found various branches of the Army were thinking the same way in a meeting called by G-4 in August. Prototypes were delivered in March and April 1952 with production contracts awarded the following December. Production deliveries began a year later.

DOES not all this mean that America has got to stop thinking of our Ordnance program in terms of developing some item for Army-wide use, producing enough for current Army requirements, and then storing the tooling against the need for all-out mobilization for war?

Certainly it would appear that America must go in for programs providing extensive field experience in a new item, then partial reëquipment with a better item. Perhaps, as air power experts recommend, the Army should have weapons-systems programs covering only 5-year spans, each program to equip only (let's say) a third of the peacetime Army and National Guard.

The lesson of the M59 tells us that a good part of the know-how behind every weapon in such a system ought to be tactical savvy: knowledge of how to fight.

This raises the third big problem posed by the M59 for economy-minded authorities: Is it not false economy to save money by keeping the Army from constant practice maneuvers when the M59 conclusively proves that not only know-how but actual big matériel cost savings can come from tactical practice?

Remember, too, that as World War II and Korean experience recedes into the past, America shall have an ever-greater need for tactical savvy gained by maneuver practice.

Mr. Hait, fully appreciating what tactical savvy can do, personnally engaged as tactical adviser a retired general of Armor, Joseph A. Holly. It was no accident, either, that seventy per cent of his engineers had combat experience, like Howard Hammond, one of the original Armored Force's artillerymen.

The Army felt the same way as Mr. Hait. Thanks to Maj. Gen. John H. Collier, chief of the Armored Center, Mr. Hait had to help him with day-to-day decisions not only an Ordnance officer to advise on technical matters but also Lieut. Col. John S. Sandiland to represent the tactical interests.

And General Collier was mighty interested, for he could see that he and the "men of Armor" he served just weren't going to get the APC's they needed for the present armored divisions they had, and those they hoped to get to offset Red tank masses, if each APC cost as much as the M75.

He had to see that a miracle was worked, and he did. He followed in the best tradition set by Gen. Jacob L. Devers, when General Marshall sent him to head the new-born Armored Force in 1940 and General Devers somehow managed in jig time to metamorphose the monstrous General Grant tank into the famous Sherman M4, making decisions in two weeks that hadn't been made in seven years.

Unfortunately, some prime members of the team that worked this miracle have been lost to the Army. Seniority rules have caused the retirement of Col. William P. Withers, president of Board No. 2 at the Armored Center and General Collier's right-hand man. Also gone is Col. R. R. Robins, who has handled vehicles in the Combat Arms Development Branch of Army Field Forces.

While youngsters helped mightily on the M59 team (men like Lieut. Cols. Nicholas Bierstecker and Garrard Foster), they would be the first to say that they just don't have the mine of tactical and technical experience and savvy of veterans like Withers and Robins. While genius may be born, know-how is made, and the making takes time.

THIS, then, raises the fourth big question posed for defense authorities by the M59 miracle: *Is our system right when it discards men who have been instrumental in saving the Nation millions of dollars, and in revolutionizing land warfare?* Would industry drop such men when they seem just to be getting into the swing of making things better at less cost?

General Simon and Mr. Hait warn us that the M59 is not the end of the development journey in its field. It is only a signpost pointing the way toward future developments.

All this has one great meaning for America and the world. It means that if the "long-haul" defense policy is here to stay, and if America truly has abandoned her childish "famine and feast" policy of arms development and production and practice maneuvering, in less time than may appear possible the U.S. Army will be able to defeat any enemy, at any time and place, and under any politico-geographic conditions.

EDITOR'S NOTE.—Unless otherwise indicated, photographs are by courtesy of *Life* magazine and are copyrighted by Time, Inc.

James L. Walsh Prize Essay Contest, 1954

THIS contest is open to all members of the American Ordnance Association who have not reached their thirtieth birthday at the closing date for entries. The winner of the contest will receive a cash award of one thousand dollars, and the prize-winning essay will be published in ORDNANCE. All essays submitted will be considered for publication, and the authors of any nonprize-winning essays published will be paid at the regular publication rates.

¶ The officers and directors of the Association established this contest last year in memory of the late Col. James L. Walsh, one of the founders of the Association and president from 1947 to 1952. The topic for the 1954 contest will be:

"Industrial Mobilization as a Vital Factor in National Defense"

¶ To be eligible, essays must be submitted on or before October 15, 1954. They must not exceed 3,000 words and must be typewritten, double-spaced, on paper approximately 8½ by 11 inches. They must be submitted in triplicate, each copy complete in itself and firmly bound together.

¶ The name of the competitor must not appear on the essay. Instead, a *nom de plume* must be used. The name and address of the contestant must be typed on plain paper and inserted in a plain sealed envelope on the front of which his *nom de plume* must be written.

¶ Essays with identifying envelope must be mailed in a large sealed envelope marked "Walsh Prize Essay Contest," to the Secretary, American Ordnance Association, 708 Mills Building, Washington 6, D. C.

Atomic Energy and the Navy

Nuclear power will not only give our naval forces unprecedented striking potential but will enable our surface ships and submarines to cruise indefinitely without dependence on organic fuels

Rear Adm. George C. Wright

ATOMIC energy has profited more than any other new field from the flexibility and the unique capability of American industry to see the military need and to transform the gleam in a scientist's eye into the awesome force of atomic warfare as well as the peaceful needs of mankind.

Great strides have been made in our atomic and hydrogen weapon developments, and the terrible destructive potential of these weapons is well known to all. Offensive power has been multiplied by a factor in the thousands with the new-found ability to split and fuse the atom.

The United States, however, does not have a monopoly on this technique—an alarming thought to all of us. It is disturbing mainly because of incontrovertible evidence that the Reds have atomic devices also.

We could also be uneasy of mind if we knew that a potential enemy had perfected atomic power for ship propulsion. This does not appear imminent, but the possibility cannot be ruled out. We Americans cannot afford to take a chance on being left behind in adapting this vital new mode of power to our naval ships. It is urgent that we master the techniques of atomic power to keep our ships and airplanes and industrial power in the forefront of all nations.

The order of magnitude of increased benefits is as great in the application of nuclear energy to ship propulsion as it is to weapons. Nuclear power will permit a ship to steam around the world, nonstop, at high speeds. These higher speeds make a ship less vulnerable to attack, particularly by submarines. The high-speed troop transports, such as the QUEEN MARY and the AMERICA, steamed independently in hostile waters without escort during the last war, relying on speed to minimize the danger of submarine attack.

Admiral Wright is Director of the Division of Atomic Energy, Office, Chief of Naval Operations, Washington, D. C. The following article is taken from an address given recently by Admiral Wright before the Michigan Post of the A.O.A.

The elimination of voluminous fuel tanks makes room for more ammunition, more aviation gasoline, or more troops. The surface ship is made more resistant to damage by the removal of funnels and cumbersome air intakes for the boilers.

The military value of the atomic submarine will be its ability to travel entirely submerged at high speeds across the ocean if necessary. The power source of a conventional submarine, while it is operating under water, is its storage battery with which the submarine can operate for only a very short period before the battery must be recharged. To do this, a submarine must operate on the surface or raise its snorkel. This greatly increases vulnerability to detection and attack.

When I became a midshipman thirty-three years ago, the coal-burning battleship, U.S.S. MICHIGAN, was in our fleet. In those days the language of the fireman was of grate bars, coal buckets, and ash ejectors. When we were steaming under forced draft, making about fifteen knots, we thought we were really kicking up quite a wake. Then the heavy work was in the fireroom where so much organic fuel was burned to get so little power out.

In the nuclear age it will be just the opposite—so little mineral fuel goes in and so much power comes out. A ship will be able to steam thousands of miles on a pound of metal, and no fireman will be permitted in the heat-generating room when the reactor is operating.

NAVAL personnel to man the first atomic-powered ships have been undergoing training during the past two years. These atomic sailors speak of moderators, control rods, crud, and xenon-override—which is a strange jargon to an old salt's ears.

As late as 1946 there was only a handful of officers in the Navy with the slightest idea about atomic energy. One of the great advantages of having land-based prototypes of naval reactors is that these power plants provide means for training our personnel so that we will have experienced crews to man the nuclear ships when they are ready for sea.

The Navy is fortunate in that much success has already been achieved in the nuclear-power program. We have

two types of submarine nuclear power plants that are in the advanced-development stage. One of each type will be used to propel our first two nuclear-powered submarines. The U.S.S. NAUTILUS, the first nuclear-powered submarine, was launched last January and christened by Mrs. Eisenhower. The "submarine thermal reactor" developed by Westinghouse will be installed in this ship.

The word "thermal" in the reactor name indicates that the neutrons feeding the reaction will be slowed down to very slow nuclear speeds. This reactor uses uranium enriched in the U-235 isotope in the form of solid pieces of metal submerged in a tank of ordinary pure water that serves both as the cooling agent and the moderator.

THE heat produced by the reactor will be taken out of the coolant water in a boiler where steam will be produced to operate a turbine to propel the submarine as well as to drive a turbogenerator to produce electricity.

May 30, 1954, marked the first birthday of power operation for the prototype of the submarine thermal reactor located at the Reactor Test Station in Idaho. This nuclear power plant is identical with the one being installed in the U.S.S. NAUTILUS. The Idaho engine has produced many million kilowatt-hours of energy, and this plant has been successful even beyond our hopes.

This accomplishment is a tribute to the coöperative efforts of the Atomic Energy Commission, the Navy, and almost 1,000 industrial organizations. We expect the NAUTILUS submarine to be cruising at sea this fall.

Already the prototype for this ship has given us such confidence in the feasibility of adapting nuclear power to naval ships that the Navy has requested Congress to approve two more nuclear-powered submarines.

Of equal importance to the Navy is the second nuclear-powered submarine, the U.S.S. SEA WOLF. The prototype for this plant is being constructed by General Electric in a very large steel sphere, 225 feet in diameter, at West Miltin, N. Y. Here a large body of scientific and engineering talent is developing the prototype as an entirely different kind of submarine nuclear power plant.

The SEA WOLF reactor delivers its heat to liquid sodium which in turn converts water into steam in a heat exchanger. This plant will have much higher steam pressure and thus better thermal efficiency than that in the NAUTILUS, but the liquid sodium has associated complications.

Each of the two radically different approaches to practical nuclear power has significant advantages. We are in the very early stages of harnessing the power of the atom for power production. In the double-pronged attack on the problems of nuclear ship propulsion we are making use of a large cross section of industrial capacity.

Even more advanced applications of nuclear-powered ships have been studied. From the knowledge that we already have gained we believe that more powerful and faster submarines can be built with comparable tonnage. We are planning the adaption of nuclear power ultimately to large ships, and here one's imagination about our future Navy knows no bounds.

These programs, aimed at specific military needs, will have far-reaching effects both on naval power and on civilian power. Historically, developments in power plants for naval vessels have found industrial applications which were unpredicted. The lightweight Diesel engines which were developed years ago for submarine propulsion led directly to the Diesel locomotives so common today.

The development of nuclear power plants for civilian use is also an objective of high national importance.

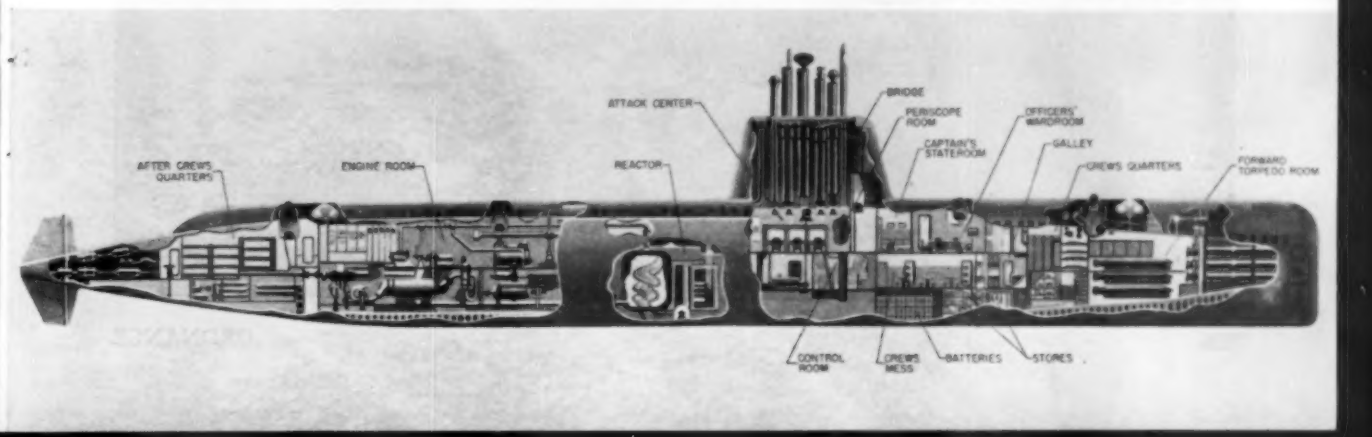
The major question before civilian nuclear-power planners is: "Will it compete economically with chemical fuel?" In the Navy, we are never unmindful of the taxpayers' dollar. We are convinced that nuclear fuel for naval purposes will be economically advantageous.

IN summary I would like to quote a noteworthy statement made by the Hon. Robert B. Anderson in an address to the Navy League at Chicago. He said:

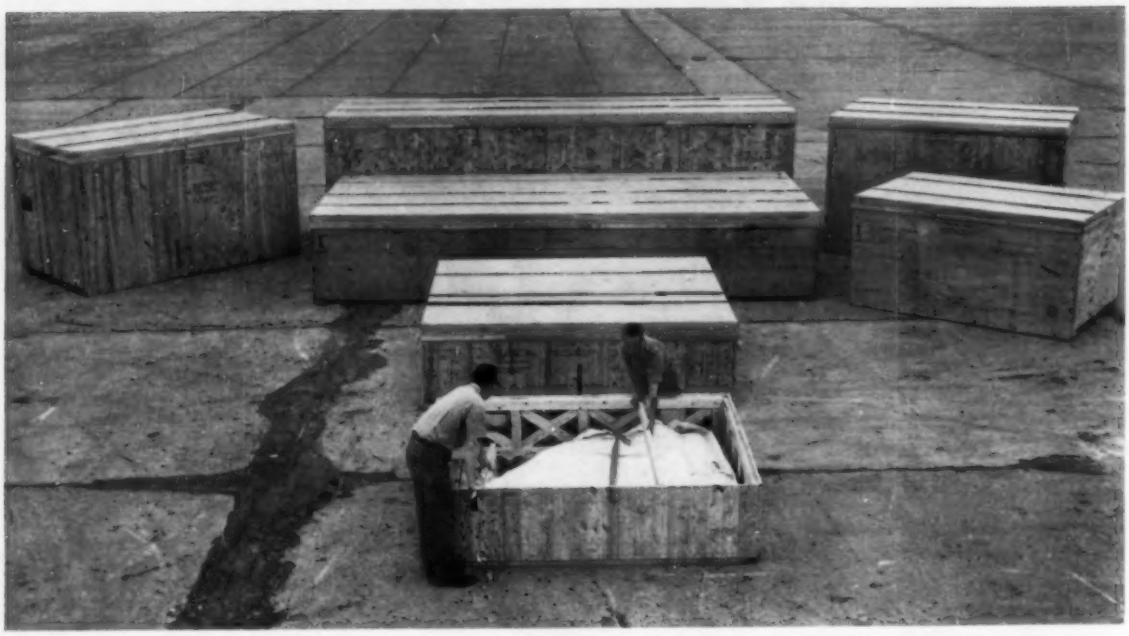
"The advent of new weapons in no way diminishes either the effectiveness of or the necessity for our sea power. The Navy is in the forefront in the development of new weapons and techniques, and in adapting them to naval use. The gun, the steam engine, the torpedo, the airplane, and the guided missiles have, in their turn, increased the effectiveness of navies.

"We have harnessed nuclear power to submarine propulsion. We shall widen and expand that use in the days to come. We may expect that future weapons, if and when they become available, will also be adapted to naval use."

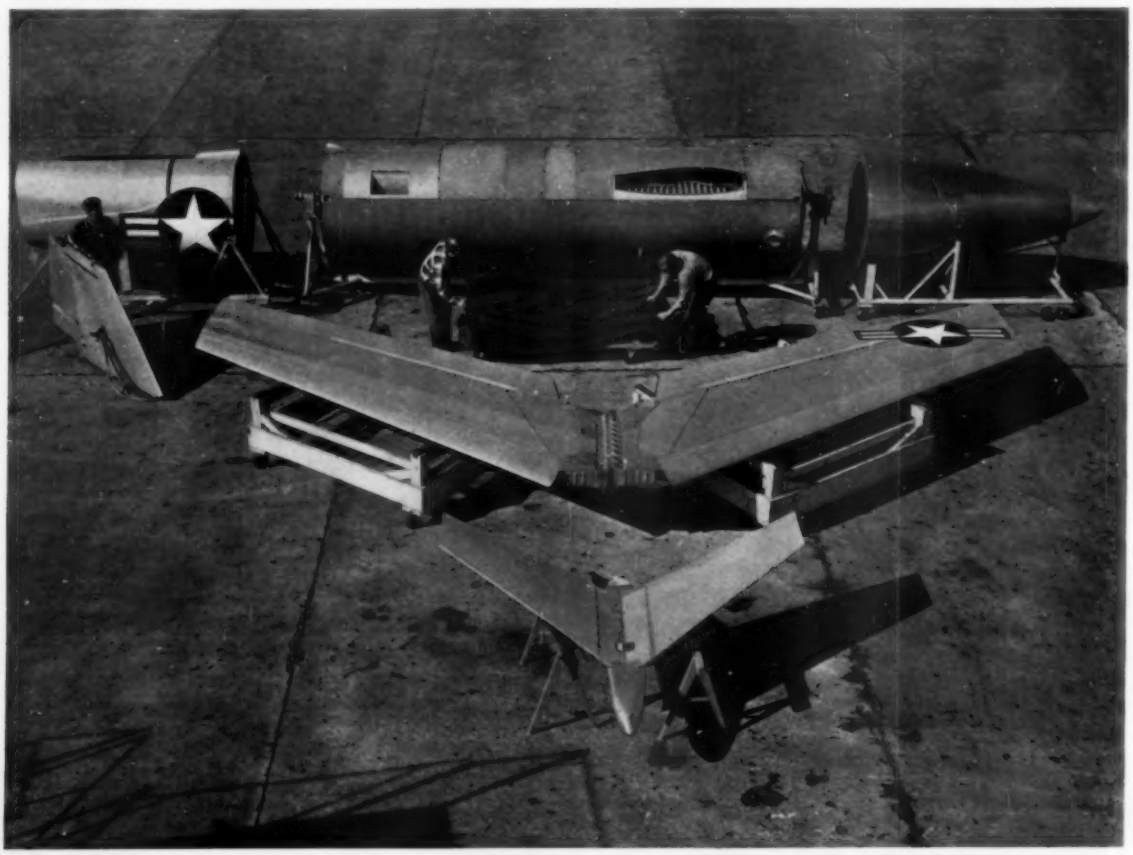
Cutaway drawing of the U.S.S. NAUTILUS, first atomic-powered submarine recently launched by the Navy (Navy photo).



Surprise Packages



The seven innocent-looking packages above hold an unassembled Matador B-61 pilotless bomber and are shipped from the Glenn L. Martin Company plant ready for use or storage. The crated parts are interchangeable, and the new technique eliminates the final assembly-line operation from the manufacturing program. The uncrated components are shown in the photograph below.



Project Nike

An analysis of the conception, planning, and execution of the many ideas and details concerned with the development of our latest rocket-powered, surface-to-air, high-speed guided missile

W. H. C. Higgins

ON December 17, 1953, the Department of Defense released the first public information on the Army's latest addition to its defense arsenal—the Nike guided-missile system. The release—covered extensively by the press, radio, and television throughout the Nation—was timed with the announcement that the first tactical Nike installations were under way at Fort George G. Meade, Maryland, for the defense of Washington and Baltimore.

Thus, after eight years of intensive research and development, Nike emerged from the secret category to become the Nation's first combat-ready surface-to-air guided-missile system.

Beyond what has already been released by the military, little can be added concerning the technical details of the Nike system. However, there is an equally interesting story which *can* be told. That story concerns the conception, planning, and execution of the Nike Project.

DURING World War II the antiaircraft gun and its associated fire-control system was brought to a high state of perfection from the standpoint of accuracy. The advent of radar, electronic computers, and power servos for the automatic aiming of guns had reduced the pointing error against targets flying predictable courses to very small values.

In fact, the radar-controlled antiaircraft guns made a very enviable record in the defense of London against the V-1 "buzz-bomb." By the end of August 1944, about three-quarters of all V-1's that reached the gun-defended area were knocked out of the skies by this powerful defense.

Mr. Higgins is director of military electronics development, Bell Telephone Laboratories, Inc., Whippany, N. J. This article is based on an address by Mr. Higgins before a recent meeting of the Capital Cities Post of the American Ordnance Association, Schenectady, N. Y.

Toward the end of the war, however, it was becoming increasingly obvious to many people that advances in aircraft design would soon result in a material reduction in gun effectiveness. The new planes would fly higher and faster and would be capable of violent evasive maneuvers even during the bomb run.

During the time of flight of the gun projectile a 600-knot target might fly as much as 5 miles, and any deviation of the target aircraft from its predicted course could result in a substantial miss.

Although many improvements were made in antiaircraft guns and fire-control systems since the war, it was clear that a major advance could only be achieved if the projectile or missile could be steered during the entire time of flight. In that way, any maneuver on the part of the target could be countered, even at high speed, by a corresponding maneuver of the missile.

It was also clear that with new airplanes flying near or above the speed of sound, the missile must have great speed. What we needed was a supersonic guided missile!

In the fall of 1944, Lieut. J. W. Schaefer, a young Bell Telephone Laboratories engineer on active duty at Frankford Arsenal, proposed a solution to the guided-missile problem based upon extensions of the existing radar fire-control art.

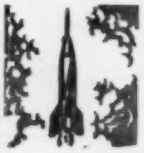
BELL Telephone Laboratories, because of their considerable experience in radar and computer techniques, as well as their broad background in other fields of the required technology, were asked to study the Ordnance proposal and to make recommendations for a development program in the event that a practical solution could be predicted.

This study was undertaken under the joint sponsorship of Army Ordnance and the Air Force and was led by Dr. W. A. MacNair, now vice-president of the Sandia Corporation, who directed the project in the laboratories for the first 2½ years. Other Bell members of the study team included Dr. Hendrick W. Bode, director of mathematical research, and G. N. Thayer, now vice-president of Bell Laboratories.

Major assistance on the supersonic aërodynamic phase of the job was rendered by Dr. W. B. Klemperer of the Douglas Aircraft Company.

Consultation on important aspects of the program was obtained from Dr. Clark Millikan of the California Institute of Technology, from scientists of the Ballistic Research Laboratories at Aberdeen Proving Ground, and from scientists in the National Advisory Committee on Aëronautics.

Among the important philosophies set down by the study team were the following:



1. The problem should be treated as an integrated weapon system—not merely as a study in radar, computers, or missiles *per se*. To be successful, it would be necessary for all parts to fit into a coördinated plan.

2. The system selected should place emphasis on simplicity and reliability of the expendible missile.

3. The system should make maximum possible use of existing technology; it should be predicated on the philosophy that no basic invention would be necessary for its success.

The study was conducted over a period of about five months with an oral report to the services in May 1945 and a formal report in July of the same year. That report formed the basis for the exploratory development which followed.

THE fact that the report stood up so well throughout the program is a tribute to the sound thinking of those who executed it. The "weapon-system" concept on which it was based marks a milestone in postwar development programs.

Upon completion of the study and report of the findings to the services, the Nike contract was continued under Army Ordnance sponsorship for a period of exploratory development. Bell Telephone Laboratories assumed project control, and Douglas Aircraft Company was brought in as a full partner under subcontract to Bell Laboratories.

Aberdeen Proving Ground assisted in warhead studies, and various other military establishments made available their wind-tunnel testing facilities and provided technical advice. Thus the skills of military specialists and two large industrial organizations were brought to bear on the solution of one of the most complex problems in applied physics ever attempted.

The development contract originally envisioned an exploratory development to verify the findings of the report and a demonstration of an experimental system at White Sands Proving Ground in New Mexico. It was recognized that this was an essential prelude to any consideration of design for production for use by troops in the field.

The program was planned in yearly phases to cover study and evaluation of radars, computers, and missile-control systems at Bell Telephone Laboratories with parallel work on the missile, booster, launchers, and aërodynamic problems at Douglas Aircraft Company.

Each year joint planning conferences were held to map out the work for the succeeding period, and numerous, less formal, meetings were held to solve specific problems as the occasion arose.

Army Ordnance participated in the planning and was kept informed of progress not only through quarterly progress reports but also by assignment of full-time liaison officers in the contractors' plants. These officers have contributed notably to the success of the program.

It has already been pointed out that in the initial phases of the project a small group of highly qualified specialists were devoted to establishing a system plan. Following completion of that work it was necessary to expand the activities into many fields. Additional engineers, draftsmen, and shop mechanics were added to the project. Their efforts were directed toward solving the many problems encountered in carrying out the development plan.

It was during this period that project management faced its greatest challenge—to guide all phases of the development toward the ultimate objective, to eliminate unnecessary explorations, to insure sound technical solutions of the problems, and to obtain compatible time schedules for each element of the system.

By meeting this challenge, project leadership makes its greatest contribution to insuring that the taxpayer gets full return for each dollar expended.

During the critical phases of the exploratory development from 1945 to 1950, this leadership was shared at Bell Telephone Laboratories by Dr. MacNair, who headed the original study, and by W. C. Tinus, now vice-president in charge of all military activities at the Laboratories. At Douglas Aircraft Company, E. P. Wheaton, chief missile project engineer, has been responsible for the Nike activities of that organization.

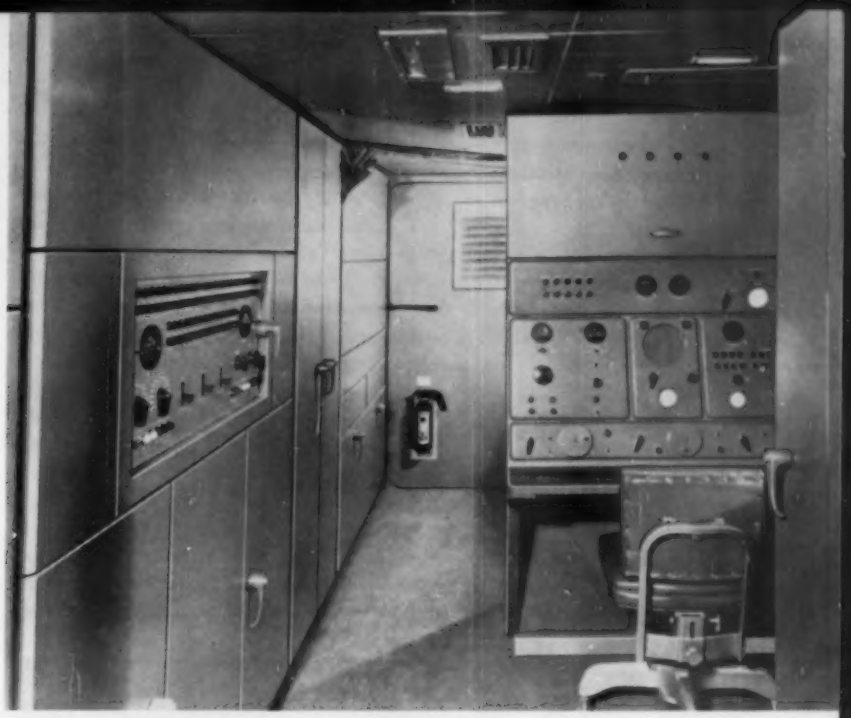
IN the early days of the project little was known about problems of launching, booster separation, and supersonic flight. Accordingly, the first missiles flown at White Sands Proving Ground in 1946 were free-flight missiles to prove these vital parts of the system and to obtain information for the next phase.

Throughout the program the missiles fired were full size and full weight, but the design progressed from the first dummy rounds to the final guided missile as the various problems of launching and guiding in supersonic flight were overcome.

While this missile work was in progress at Douglas Aircraft Company and White Sands Proving Ground, guidance equipment was being developed at Bell Telephone Laboratories. Thus, all parts of the program proceeded simultaneously toward the original objective—to demonstrate that the basic concepts of the system were sound and that a practical system could in fact be built to destroy high-speed maneuvering aircraft.

The objective was realized in November 1951 when the Nike missile system obtained a successful intercept of a drone aircraft on the very first attempt. Damage to the drone was avoided by the use of a spotting charge in the missile rather than an explosive warhead. However, on several succeeding firings drone damage was produced by direct hits even though no warhead was carried.

This phase of the program was concluded in the spring of 1952 with the firing of live warhead rounds against



Trailers housing ground electronic equipment are necessary for a successful Nike firing. At right, interior view of the radar trailer showing the operating position for the radar technician. Below, control trailers and radar scanners are set up for test firing of the Nike at White Sands Proving Ground, N. Mex.

Right, interior view of battery control trailer showing plotting boards and operating console on left. Cabinets housing complex electronic computer are at right rear.

a violently maneuvering drone aircraft. The results were spectacular as you will see later in the program.

BY the spring of 1950 the exploratory development program had progressed to the point where Army Ordnance requested Bell Telephone Laboratories to undertake the development of a guided-missile system suitable for use by troops in the field. The exploratory program had not yet been completed, but the progress was sufficiently encouraging to give assurance of success.

Agreements were reached to proceed with this new development in parallel with the completion of the exploratory phase. The tactical version of Nike was to be known as Nike I.

Launching section of a Nike battery with four missiles in firing position.

In order to carry out this new addition to the Nike program, engineers at both Douglas Aircraft Company and Bell Laboratories were assigned the problem of determining the characteristics for the new tactical system.

The problem here was considerably different from that encountered in the initial Nike study. Many of the technical problems had already been solved. What was needed was to determine performance capabilities, system parameters, and equipment configuration for a tactical system to be operated by troops in the field.

Consideration had to be given to problems of logistics, transportability of the equipment, maintenance, extreme climatic conditions. Decisions had to be reached on the types of targets against which the new weapon was to be used. How high and how fast would they fly? At what ranges must they first be detected for effective engagement? What should be the composition of the fire-control unit? What plans should be made for fitting this new defense weapon into the already existing defense network?

These and many other questions were considered and answered by the group assigned to determine the tactical plan. Close liaison was maintained with the engineers assigned to the exploratory development program and with the various agencies of the Army to insure that full advantage was taken of the technical advances in the program and the needs of the services.

THIS group prepared a report covering the characteristics proposed for the Nike I tactical guided-missile battery. The report covered in detail the composition of the battery, housing facilities in lightweight air-transportable trailers, provisions for integrated test facilities, and equipment for the assembly, test, fueling and arming of the missile. The development proceeded based upon the findings of this report.

Although military security prevents my telling you in detail information presented by this study, I should like to describe some of the equipment developed for Nike I. The radars and van-type trailers for housing the electronic equipment make extensive use of magnesium and aluminum to produce lightweight designs capable of ready air transport.

THEY are also designed for a high degree of mobility over improved and second-class roads as well as over rough terrain. Special precautions are taken to protect the electronic equipment against road shocks encountered in this service.

In tactical use the Nike is fired by a missile-launching section from a number of portable launchers. Associated with each is a ready rack with additional missiles for quick installation in the launcher. In the center of the section is a sandbag revetment for the protection of operating personnel.

The Nike round consists of two parts —the missile proper and the solid rocket booster. The latter is used for quickly accelerating the missile to supersonic speed. After separation from the booster, the missile continues to accelerate with power supplied by its own liquid-fuel rocket motor.

Two sets of steering fins are provided for control of the missile during the flight. The missile itself is approximately twelve inches in diameter and about twenty feet long. In addition to the liquid-fuel power plant, it contains electronic control circuits and hydraulic actuating mechanisms, as well as the explosive warhead.

In developing the ground electronic equipment, one of the first steps made was to construct a wooden mock-up of each trailer required. The use of mock-ups permitted critical examination of equipment layout, operators' controls, and other factors contributing to ease of operation by soldiers in the field prior to cutting metal for the actual equipment. Tests could be made to insure adequate lighting, heating, and ventilation.

In planning the radar console in the trailer, considerable attention was given to the correct placement of operators'

controls and to insuring that each operator would have no more duties to perform than he could reasonably be expected to do under the stress of an actual enemy engagement. Various signal lights provide information on the status of the battery operations (see photo top of page 229).

A wooden mock-up was first made of the battery-control trailer and, finally, the finished equipment. Associated with the operating console are plotting boards which provide the battery commander with an over-all picture of the tactical situation.

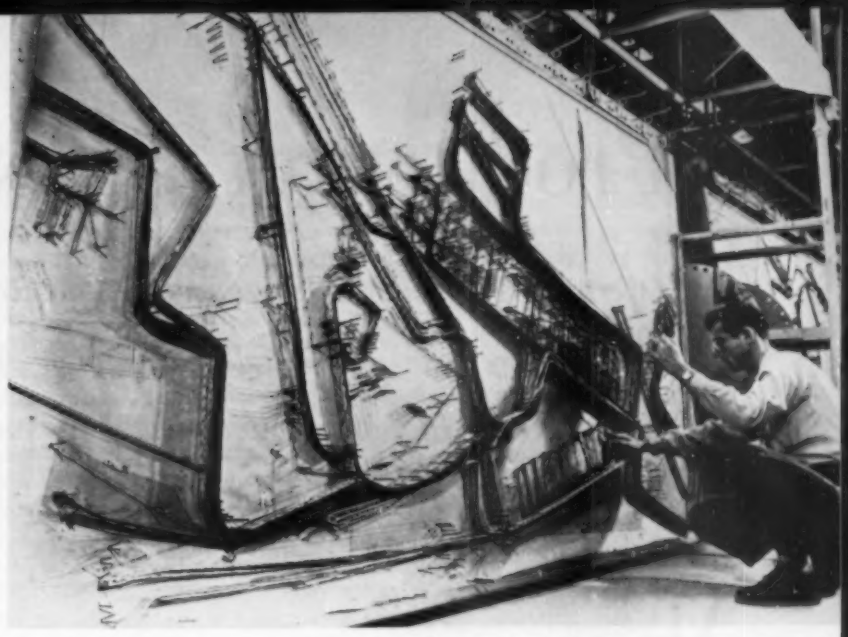
Also available to the battery commander are the various signal lights and controls necessary for the effective conduct of his mission. To his right is a telephone switchboard for communication both within and outside the Nike battery area. Other cabinets provide housing for the heating, ventilating, and electronic equipment necessary for the operation of the system (see photo at bottom of page 229).

The actual trailers are constructed from magnesium-faced paper honeycomb panels which combine maximum rigidity and strength with minimum weight in keeping with the services' desire for air transportability. Wiring and ventilating ducts are provided within the trailer panels.

ON one side of the battery-control trailer are the electronic cabinets, telephone switchboard, and operating console. On the other side are cabinets housing the complex electronic computer. In all these cabinets the electronic circuits are divided into small plug-in type chassis to facilitate field maintenance.

Nike I is now in full-scale production by the Western Electric Company factories and by the Douglas Aircraft Company. Hundreds of subcontractors of these two concerns throughout the country are contributing their share to the success of the Nike guided-missile system.

Photo at top of this page shows a cable board on which is being assembled some of the cabling required within the Nike trailers. The technique of prefabricating cables in this manner was developed many years ago for use in telephone equipment. It has been found to be extremely useful as well in the construction of equipment for the military services.



Above, technician assembles some of complex cabling required within the Nike trailers.

The missiles, launchers, handling equipment, assembly equipment for the missile, and the unequipped trailers are produced under contract between Western Electric Company and Douglas Aircraft Company. The electronic components for the missile, however, are produced in one of the other Western Electric Company plants.

Throughout most of the development of Nike we have been very fortunate to have as our Army Ordnance program director Brig. Gen. H. N. Toftoy, now commanding officer at Redstone Arsenal.

Last summer in Los Angeles, General Toftoy acted as chairman for a classified presentation of Nike to the Institute of Aëronautical Sciences. During his introductory remarks he pointed out the difficulty of carrying out such a project when the companies involved were 3,000 miles apart.

"It is interesting to note," he said, "that the success of the project under these conditions was made possible by the rapid communications and transportation provided by the peacetime products of these two concerns—the telephone and the airplane."

Below, Western Electric assembly line for the accurate radars used in the Nike system.

Production Preparedness

"Operation PEQUO" with headquarters at Rock Island Arsenal will help preserve our industrial mobilization base by keeping vital machine tools inventoried and ready for any national emergency

Brig. Gen. T. A. Weyher

General Weyher is commanding officer of Rock Island Arsenal, Rock Island, Ill. The following article is based on a recent address by General Weyher before the Quad Cities-Iowa Post of the American Ordnance Association.

MUCH of the damage done immediately after the last war to our war-making and corollary war production capacity has been repaired. While we cannot even yet mobilize our whole potential strength in less than several months' time, military equipment of advanced design and high combat effectiveness is now on hand or in sight in sufficient quantity to meet likely demands.

These quantities are, however, far short of the total needed to wage an all-out war. We are now faced with the task of finding ways and means, in the face of curtailed military production, to satisfy total requirements when the need arrives.

First, I shall try to explain more fully why we need to preserve such capacity; secondly, I shall give an indication of the magnitude of the capacity of which we are speaking; and, thirdly, I shall briefly go over the plan by which we are trying to implement it.

IN World War II we felt fortunate if a contractor delivered his first acceptable piece of "shooting" ordnance in sixteen months. It usually took longer, the average being eighteen months, with twenty-four months on some items being not unusual.

Since most producers, who lacked their full complement of machine tools in the early stages, did not hesitate to use their toolrooms where necessary, this time primarily represented the time required to produce, prove, and correct special tooling and to train people.

By the time this was accomplished, early problems of deliveries of materials, gages, and, to a lesser extent, those of machine tools and facilities were largely solved so that these factors were not normally the controlling factors in deliveries.

At the conclusion of World War II, planning was done on the assumption that there probably would be no major war in less than fifteen years and certainly none in less than five years. We were immediately faced with a probable large unemployment problem. Men in the Army clamored for their discharge; production of military goods all but ceased.

The possible unemployment of millions of ex-servicemen plus the loss of employment of additional millions who were engaged in military production gave rise to a specter calculated to shake the equanimity of the most phlegmatic public official or member of Congress.

A climate approaching frenzy was created. All planning and all action seemed to be subordinated to the one requirement—reconversion of industry to the production of civilian goods.

Rapid plant clearances of work-in-process inventories, of materials and parts, aids to manufacture, production equipment, and whatever else pertaining to war production that stood in the way of civilian production in those plants became the order of the day. So successful was this effort that unemployment never was a serious problem —somewhat to the surprise of us all.

Nevertheless this factor had the end result of destroying much of our physical capacity to create military products.

FROM the chaos and confusion of those days certain benefits emerged. Our arsenals were modernized with machine tools from defense plants. In 1940 about three-quarters of the machine tools at Rock Island Arsenal were over twenty-five years of age.

In 1945-1946, a few far-seeing folk at Rock Island and at other arsenals seized the opportunity to earmark and acquire machine tools so that now no one need offer any apology for the state of their equipment.

True, many "clunkers" found their way into our industrial machine-tool reserve outside the arsenal system, but many good tools were also saved.

Our performance in destroying our mobilization base in 1945 must not be repeated again. There are three important differences in the situation now as compared with that of the early postwar years. International tensions have mounted considerably so that the hazard of armed conflict is much greater than it was then. An uneasy truce prevails in Korea. No one can say whether or not hostilities will be resumed there or

where events in Indo-China will lead us.

The second difference is in the increased vigor and effectiveness of our research programs. These programs, at least in Ordnance, are at about the proper level for the long haul. They do, however, represent a dynamic, progressive effort—much more intense than those we have made in the past. The programs are certain to result in weapons systems and components of high effectiveness.

No one will argue against the philosophy of exploiting to the utmost our scientific and engineering capabilities in industry to offset the numerical preponderance of our potential enemy by the supply of technologically superior weapons systems to our troops.

THESE ultimate designs must be converted to metal by production processes at the last moment in order to take advantage of the latest advances in weapons system technology.

Our experience with those World War II contractors who participated in the production of items for Korea identical with those of World War II leads us to the sad conclusion that too often such know-how as existed in World War II had been forgotten or dispersed to a great extent by 1950.

Therefore, prudence compels us to plan on the same production lead times as obtained in World War II unless we can advance the production release date or pick up the production process at some point further along the sequence of steps which must be taken to produce munitions.

To advance the production release date too far will make it impossible to take full advantage of the latest designs and may give us second-best weapons. The alternative is to make it possible to have some of the preproduction work done before an emergency strikes. The Ordnance plan has the latter in mind.

A close relationship exists between the two differences mentioned above and the third to which I now come. In the past, for all practical purposes, the national approach to war production has had no adequate "lead-time" phase. Today our hopes are pinned to a considerable extent on provisions for lead time.

It is obvious that national industry requires some time for conversion from consumer to military type production, particularly under war conditions. The accomplishment of that purpose is conceived in a plan for a national industrial mobilization base.

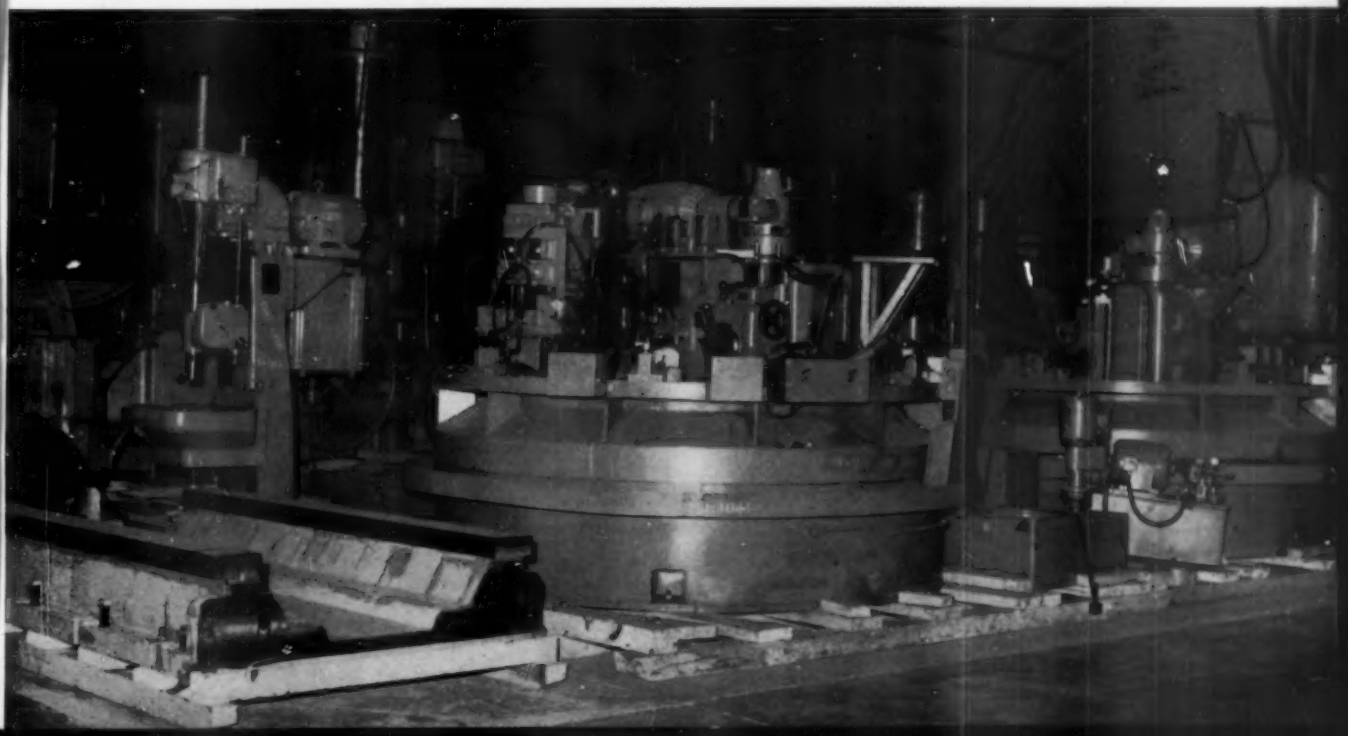
The industrial base fits into the picture in maintaining current needs and the flow of supplies between the time initial aggression is met with available resources and the time that national production capacity is geared to the sustained effort in supplying material of the latest design to support military operations over the indefinite period of all-out war, should that come.

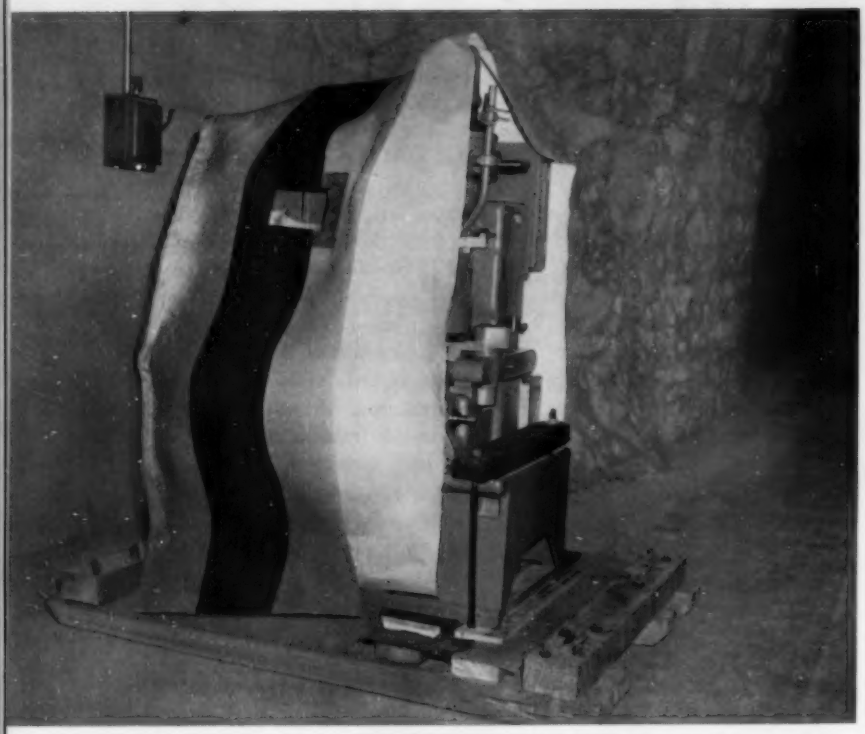
Perhaps an alert readiness would give an aggressor more reason to pause. By maintaining key facilities, essential current know-how, and integrated elements of early military supply, the industrial base bridges that gap which heretofore existed between available national power and potential power. Americans concerned with the world situation and our defense recognize this need.

Provisions thus designed for power to preserve peace are economically feasible, avoid waste, and must meet with the approval of any loyal citizen who gives the matter mature consideration.

WHAT can we do now with the vast production potential we have developed since 1950? It does not seem desirable or feasible to try to maintain greatly reduced production indefinitely in all these plants. Such a costly program would throw doubt on the possibility of continued national support.

The Ford medium tank line laid away in readiness for reactivation as part of the PEQUO program.





Cutaway of a complete moisture vapor barrier closure, one method of treatment for storage of valuable machinery in an uncontrolled atmosphere.

We realize full well that the capabilities of men must stand as the number one factor for consideration in any war production program. Without production in civilian plants, experience has shown that the know-how in these plants is quickly dispersed, only to be reconstituted at the expense of much time and money.

After giving due weight to these factors we must, however, conclude reluctantly that we should focus our attention on the preservation of the physical means of production rather than continuing production itself, even though in time the work force becomes scattered.

WE are confronted with two major situations in our dealing with industrial capacity. One embraces the so-called mixed facilities where munitions production has been achieved by balancing contractors' plants for munitions production by the supply of Government-owned equipment.

The second is the type of facility created at Government expense for the production of specific end items of munitions. Supporting production of either type is a more or less complex subcontractor structure.

WHATEVER solution we adopt for the preservation of essential capacity, it must be within the economic limits the Nation is willing to support over an indefinite period. We must also consider the impact of our program on the strength of subsidiary industries such as the machine-tool industry. It must consider the problem of obsolescence of production equipment, as well as of end items of special tooling and gages, and make adequate provision for modernizing such things before needed for full-scale production.

The program should be impervious to adverse, ill-advised, short-sighted, arbitrary decisions because, in the course of twenty years, danger to the program from such a cause is very real. We must also reflect that in two war periods our current procurement programs, during the "twilight" era of limited emergency, have set the pattern for our later expansion, often without regard to carefully thought out mobilization plans.

This is another issue, but it is apparent there should be a single procurement program—that for "all-out" war. Any current procurement must be consistent with and partially implement that program.

Since we did not create all the capacity we needed for "all-out" war during the Korean emergency, wisdom dictates that we maintain such effective capacity as we have to the greatest degree of readiness consistent with reasonable cost. With "mixed facilities" the problem of leasing production equipment to plant owners can become acute.

IN order to keep a powerful machine-tool industry in being, orders for new equipment are necessary. In order, also, for our country to have modern equipment in its plants it is necessary for Government-owned equipment to be replaced as it becomes obsolete.

Government-owned equipment may be leased to private industry under certain necessary restrictions. Under this plan a leasing arrangement may be approved by higher authority where it can be shown that the best interests of the Government and industry are being served.

The principal consideration is whether such arrangement is in any way detrimental to the preservation of a vigorous machine-tool industry. Moreover, it is essential that provision be made for replacement of machine tools when they become worn out or obsolete.

CONSIDERATION of the factors enumerated has led to the development of a plan which we feel represents the minimum we must do. It is imperative that our people realize we cannot continue to repeat the foolhardiness displayed toward readiness for defense in the past without sooner or later encompassing our destruction.

The program will cost money. It is necessary in each individual case to find the optimum solution. What we have developed is a flexible plan to fit a variety of situations. For most programs the capacity we have developed falls short of that needed for all-out war. We can, therefore, go on the premise that we would, in general, like to preserve all the good capacity we have developed.

Keeping in mind the lessons of two World Wars and Korea when production of weapons and munitions often was delayed pending procurement of the necessary machinery, Army Ordnance is engaged in the huge task of inventorying more than $2 billion worth of equipment owned by Ordnance.

"By maintaining key facilities, essential current know-how, and integrated elements of early military supply, the industrial base bridges that gap which heretofore existed between available national power and potential power."

KNOWN as PEQUO—an abbreviation for Production Equipment Office—the undertaking is not only an insurance against some future national emergency but could obviate the expenditure of perhaps hundreds of millions of dollars should such an emergency arise. Of far more urgent value would be the reduction in lead time required to obtain production.

Rock Island Arsenal has been selected as the site of PEQUO and is responsible for the central records and administration of Army-owned machinery in this program. To date about 125,000 items have been inventoried. This figure is expected to reach 200,000 before the records of Ordnance-owned production equipment are completed, and, in the near future, PEQUO will set up similar records for the other technical services of the Army. Combined, some 250,000 items will be cataloged.

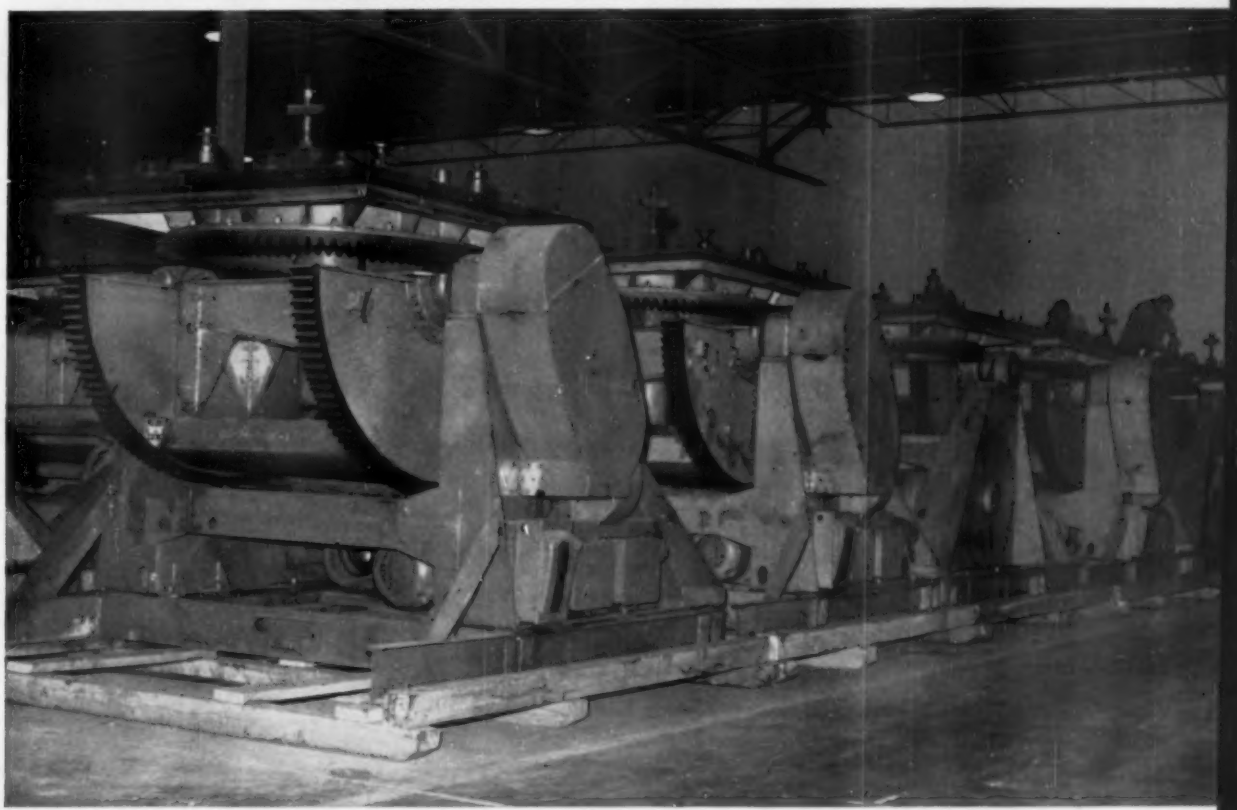
Events leading up to this centralized control go back many years and culminated in the formal establishment of the Production Equipment Office in February 1954. Ordnance Corps experience contributed heavily in this constructive step.

As an important manufacturing arsenal, centrally located, Rock Island has procured over a period of time substantial quantities of machinery as a normal part of its mission. The Chief of Ordnance has seen fit gradually to expand this service into what is now the arsenal's Army-wide responsibility regarding production equipment.

The value of the machinery program and inventory data cannot be measured in dollars alone. The time bought and the potential provided by ready production capacity have no price tag. We are embarked today on a defense machinery insurance program that is the best we have ever had. It is one that warrants public support. By means of that program we hope to avoid critical problems encountered in the past.

AN adequate industrial-mobilization base as envisioned by this program not only promises to provide timely military supplies but also tends to relieve the congestion generated in the machine-tool industry by sudden and conflicting demands for machinery to meet immediate emergencies. In view of world conditions, an industrial base is one type of insurance we cannot afford to neglect.

Specialized welding positioners are placed, unwrapped, in specially controlled, dehumidified storage for preservation.



Month by Month: Highlights of the National Defense

Industrial Defense

Most sensible people, and that includes all of us, make provision for a rainy day. But just suppose the rainy day turns out to be A-bomb day. How prepared are we for a sneak enemy air attack?

Everybody can be very eloquent on the subject of being at least as provident as squirrels. But the record shows that disaster planning is still a rarity in America and, of all places, in American industry. Only a few companies have plans in instant readiness in the event of an atomic attack.

The number of such companies, however, is gradually increasing. Government officials say that there is a quickening concern over the problem of how to protect "corporate interests" in the atomic age.

One obsolete suggestion has been to move present industrial concentrations underground or to disperse them widely in remote areas. Such moves, of course, are prohibitive on a large scale because of expense.

The Government is offering fast tax write-off incentives for the establishment of *new* plants away from congested areas. Such incentives are realistic and effective.

> *During 1953, for example, 215 plants, costing $1.7 billion, were built at least ten miles away from the outskirts of "target areas." These firms accounted for about 78 per cent of the $2.2 billion of plant construction and expansion covered by tax write-offs last year.*

With respect to existing plants, industry must rely on the military's air and ground defense shield. At the moment the vast bulk of American industry is almost completely unprepared for an atomic attack. Heavy industrial concentrations offer enemy bombers choice targets. Ten H-bombs might destroy as much as seventy-five per cent of total American steel capacity if dropped in areas where steel mills are heavily concentrated.

One American firm, Koppers Company, a big producer of chemicals and steel-mill equipment, assumes that any attack on downtown Pittsburgh would inflict considerable damage on its headquarters and has worked out a disaster plan which Government experts consider a model for other plants to follow.

Koppers has chosen a secret "reorganization point" outside of town. Key management officials and a nucleus of operating personnel are under instructions to head for this emergency headquarters at the first warning of an attack.

> *The company has already secured space in two bank vaults near the reorganization point where microfilm and other duplicates of company records are stored.*

The Koppers plan does not insure against production facilities being knocked out if enemy atom bombers break through our national defense shield. What the Koppers plan does do is to "insure continuity of management so that steps can be taken as quickly as possible with a minimum of confusion to get production going again."

The American Ordnance Association has always emphasized the supreme importance of qualified manpower in peace and war. A.O.A. membership constitutes a priceless reserve of such manpower and is our one sure hope that, in the event of vast material destruction of offices and factories, our Nation will rally from the blow and face up to the responsibilities of the dark moment with courage and competence.

The Air Academy

When the new Air Academy, the future "West Point of the Air," is established at Colorado Springs, Colo., a long-felt need will have been filled. Announcement of the new service academy brings realistic recognition of Air Force demands for officer personnel.

> *But the Air Force is not waiting for construction of new facilities to launch its own undergraduate institution. A temporary location is being established in rehabilitated buildings at Lowry Air Force Base in Colorado Springs.*

Lieut. Gen. Hubert R. Harmon as the first superintendent will greet the initial class of air cadets in July 1955. Two years later they hope to move to the permanent quarters.

General Harmon has been special assistant for Air Academy matters at U.S.A.F. Headquarters during the 5-year campaign to establish this greatly needed adjunct of the Air Force officer-training program.

About 300 students will matriculate in the first class. Competition is expected to be vigorous, with each Congressman authorized to name up to 10 candidates to compete for the 300 billets. These will be divided among the forty-eight States in proportion to their congressional representation.

When the Air Academy gets into full swing in about 3 years, with an expected enrollment of about 2,500, appointments will be handled similarly to those for Annapolis and West Point now.

This is a great career opportunity for the boys from 16 to 22 who stand highest in the mathematics, English, and history examinations and the scholastic and pilot-aptitude tests.

Submarine Defense Progress

The atomic-powered submarine has not outstripped submarine defense developments.

It would appear logical that the same atomic power used to propel a submarine could also be employed to destroy hostile underwater craft. Thus atomic submarine gains would be offset by equally effective antisubmarine atomic devices.

> *This theory at least points the way to tomorrow's developments. Even*

as things stand now, new technological progress has given the "ASW" (antisubmarine-warfare) experts an advantage in the continuing struggle between submarine designers and those charged with the responsibility of creating a defense against undersea marauders.

Today's antisubmarine-warfare system comprises a great complex of ship-based and shore-based equipment. Visual search radar and sonar, radio-direction finding, magnetic airborne detectors, surface ships of many types, land-based patrol planes, blimps, helicopters, carrier-based airplanes, and submarines are all used to hunt down and destroy hostile submarines.

A modern antisubmarine unit consists of a fast carrier, 6 helicopters, 15 Grumman S2F 2-engine planes, 8 jet fighter-interceptors, and various types of detection equipment and specially designed armament.

The latest antisubmarine detection devices make it possible to hunt down an enemy submarine more quickly than ever before. Once found, it is now practically certain that the hostile submarine will be destroyed.

The American Ordnance Association is thoroughly alive to the growing problems of adequate equipment for undersea warfare. In close contact with the Bureau of Ordnance of the Navy, the Association has established an underwater Ordnance Division—newest of its technical advisory groups—to assist in this vital phase of defense.

Picatinny Anniversary

More than seven thousand persons, including high officials of the Federal Government, State, and neighboring municipalities, and distinguished scientists, industrialists, and civic leaders of many New Jersey communities, attended colorful ceremonies in observance of the seventy-fifth anniversary of Picatinny Arsenal at Dover, N. J., on July 2nd.

Maj. Gen. Leslie E. Simon, Chief of Research and Development, Office of the Chief of Ordnance, delivered the main address. Brig. Gen. William L. Bell, Jr., the arsenal's commanding officer who has since left to take over command of the White Sands Proving Ground, also spoke.

Featuring the program was the dedication of the Samuel Feltman Ammunition Laboratories, previously known as the Research and Development Division. The dedication honored the memory of Mr. Feltman, a native New Jerseyan who became one of the country's outstanding ballisticians before his death in 1951.

The dedication address was made by Brig. Gen. Norman F. Ramsey, Retired, a former commandant of Picatinny.

The present arsenal, Phoenixlike, rose from the ashes of the old Picatinny which was destroyed by an explosion at the Lake Denmark Naval Ammunition Depot in July 1926.

Picatinny's proud record, during the past quarter of a century, has been due to the administrative genius of such commanding officers as General Bell and General Ramsey, and to the extraordinary ability of many Ordnance scientists in the field of ammunition who rendered distinguished service to the Nation.

The Picatinny story recalls to mind very vividly the personalities and achievements of such giants of artillery-ammunition progress as Dr. G. C. Hale, Arthur Adelman, Dr. C. G. Storm, Col. Beverly W. Dunn, Col. O. C. Horney, Col. J. C. Nicholls, and many other outstanding and dedicated men who have since passed to their eternal reward.

Picatinny is convincing proof of the continuing need for peacetime or cold-war arsenals to keep alive and to foster and advance the difficult art of powder making.

The New Light Brigades

Top Defense Department and Army officials visited Fort Bragg, N. C., in July to witness a spectacular demonstration of the power and capability of airborne troops.

The principal feature of the demonstration was a mass drop of a 720-man combat team, six 102-mm. howitzers, and twelve jeeps from thirty-six C-119 Fairchild Flying Boxcars.

One of the spectators was Gen. Matthew B. Ridgway, Chief of Staff of the Army and wartime commander of the 82nd Airborne Division. He said that his ultimate objective was to make all types of Army divisions air-transportable.

General Ridgway recalled that only a few years ago the only artillery with an airborne division was a few 75-mm. pack howitzers. Today such a division has 105-mm. and 155-mm. guns and M48 and M41 tanks, while the corps provides the 280-mm. cannon and the Honest John rockets as needed.

"What is not generally recognized," General Ridgway said, "is the time it takes from intentions and drawing boards to get new weapons in the hands of the troops. It takes years. But if the weapons aren't there when you need them, they are no good. Modern weapons are useless unless they are in the hands of men determined to fight and trained to do it."

Current plans call for the build-up of forces that can be transported and supplied almost entirely by air. It seems certain that atom bombs will bring bigger battlefields and the wider dispersal of troops to avoid heavy casualties. When front lines are smashed by a superbomb, reënforcements will have to be rushed by air to meet advancing enemy troops.

Army production in the years ahead will probably emphasize new kinds of lightweight arms and equipment. The Army's new "light brigades" will rely a lot less on mammoth vehicles and bulky artillery that cannot be airborne.

As a lightweight straw in the wind, all overweight airborne troopers at Fort Bragg have been ordered to shed excess poundage and to report monthly on the sweaty progress they are making. One officer recently turned in eight inches of a lightweight belt with his monthly report!

Enough Is Enough

The House Government Operations Committee is getting its teeth into a number of legislative proposals aimed at getting Government out of competition with private business.

This sort of thing has been going on

for many years, but this time our tax-paying private-enterprise system is really stirred up by the energetic activities of such tax-free competitive Government businesses as coffee roasting, theaters, ice cream cones, bakery goods—and dentures.

> *A lot of people were dreaming up lots of new laws, with teeth in them, to take Government out of business when a representative of Government itself testified that he also had his teeth in the problem and was making some incisor progress in getting Government out of business.*

Thomas Pike, Assistant Secretary of Defense for Supply and Logistics, told the House Committee that the military services are making a detailed study of thirty-one types of Government activities ranging from the operation of laundries and dry-cleaning establishments to the manufacture of argon and freon gas. He said results of these studies will begin to come in very soon.

"It is strongly recommended," Mr. Pike said, "that we be permitted to proceed with what we firmly believe to be a sound program presently in operation and now gaining momentum which will accomplish the common objectives quickly and effectively."

Maybe we should save the wear and tear on our dentures until Mr. Pike's program has had a fair chance of getting Government out of business. If Mr. Pike fails us, the lawmakers can always sink their dentures into the problem again and get a law, with teeth in it, that will forever keep Government out of competitive civilian business.

Where there is no such peacetime industry—notably the design and development of armament—our arsenals and product centers must be maintained by Government at maximum efficiency to keep the ordnance art alive. But as for dentures, etc.,—the bite is on them!

Tank Laboratories

The Army's new Tank-Automotive Engineering Laboratories, formerly the Chrysler Tank Arsenal, were dedicated in July. All the Army's automotive research and development facilities will now be concentrated on a 340-acre tract a few miles north of Detroit.

Tank and armored vehicle production will be continued beyond June 1955. The new procurement program will include M48 medium tanks, the M59 armored infantry vehicle, the M42 twin 40-mm. gun motor carriage, and the 5-ton cargo truck.

The laboratories will not be in competition with the automotive industry's own research programs but will supplement them. Most basic research will continue to be done in private laboratories. The Army will merely pick up where the private laboratories leave off in order to test its own theories and special requirements.

Service Careers

Air Force Secretary Talbott recently reminded the Nation that it is pouring out between two and three billion dollars a year on training replacements which need never be spent if service conditions were improved.

> *Pay increases and the restoration of other benefits, he declared, would bring savings of four to five dollars for every dollar spent.*

Mr. Talbott stated that only one in four airmen plan to sign up again, and that in some key units the reënlistment rate is as low as ten to fifteen per cent. Next year the Air Force expects to lose 200,000 fully trained men whose replacements will require the expenditure of an average of $10,000 a man for training in the complexities of modern air power.

At the precise time that there is such a hue and cry for trained personnel, a great number of superior officers are being relieved and retired under the law. In many cases the armed services are losing a great wealth of experience and ability that is sorely needed.

The latest suggestion to make service careers more attractive emphasizes longer tours of duty. Frequent changes of station for an officer with a family mean not only disrupting the household and education of the children but inevitably result in personal expenses beyond those paid by the Government.

Tax relief should be given retired military personnel. Living conditions for military personnel and their families should be improved. Recognition should be given to technical specialists. Assignments should be made, as far as possible, in terms of individual abilities and preferences. The military services contain far too many disgruntled square pegs in round holes.

Finally, every effort should be made to lessen the impact of a seemingly impersonal and unfeeling bureaucratic machine that apparently ignores the human factor in day-by-day operations.

Strategic Stockpiles

The General Services Administration purchase program is lagging behind its goals with respect to seven domestically produced metals and minerals.

> *In order to get increased mineral production, the Government has agreed to pay the going price for the commodity. Producers can sell either to the Government or on the open market, whichever offers the best price.*

The purpose of the purchase program is to stimulate production of strategic and critical materials. It is expected that most of the material accumulated will eventually be channeled into the Nation's strategic stockpile.

Here is the purchase record, as of June 30, 1954, for each of the seven short-supply commodities:

Tungsten: Deliveries totaled 985,295 short-ton units (20 pounds each) against a goal of 3 million short-ton units.

Manganese: Deliveries stood at 7,762,000 long-ton units (22.4 pounds each) against a program of 37 million long-ton units.

Chrome: 64,282 long tons of ores and concentrates against a goal of 200,000 long tons.

Mica: 3,413 tons of all types against a goal of 25,000 tons of hand-cobbed mica or the equivalent.

Beryl: 266 tons and a goal of 1,500 tons.

Asbestos: 295 tons against a goal of 1,500 tons.

Columbium-Tantalum: 4,666,271 pounds delivered in a program of 15,000,000 pounds.

Army Logistics

An Editorial

LOOKING back over his wartime experiences in Africa and Europe, Field Marshal Montgomery made this classic observation: "The problems of World War II were four-fifths supply and one-fifth strategy and tactics."

Most field commanders would readily agree with Monty. They would recall that it required six tons of shipping space to equip a soldier at the front and another ton a month to to keep him there.

During the European campaign, 21,411,899 tons of supplies of all kinds were discharged in European ports—approximately 4 times the 5,418,238 tons unloaded in Europe during the First World War.

Our Army has always clearly recognized the pivotal rôle of logistics in modern warfare—before the shooting began. Highly experienced military and civilian experts have invariably worked out a practical logistical plan that was intended to go into effect the moment war was declared.

But the record shows that just as soon as the plan was working successfully it was deftly scuttled by some unknown efficiency management expert from afar who hopped a plane to Washington, took a quick look around, and promptly decided to introduce, in the very midst of hostilities, his own starry-eyed logistical blueprint for victory.

During World War I—right square in the middle of it—the Army suddenly introduced something called the Purchase, Storage, and Traffic Division that unduly and unnecessarily complicated the supply problem for the remainder of the conflict—and was immediately abandoned on Armistice Day.

The Army repeated the blunder in World War II. In the midst of the war it was decided that the appropriate time had come to introduce a completely new logistical plan—a cumbersome, time-consuming mountain of red tape called Army Service Forces. The moment Tokyo surrendered, ASF was abandoned. Its logic was good; its application was not.

IN the light of this sad historical record let us now take a look at the recommendations of the Advisory Committee on Army Organization (Davies Committee) which have been approved by the Secretary of Defense and are being implemented by the Army.

The major change in the internal structure of the Department of Defense will be in that part which deals with the supporting services and matériel. For the first time the permanent organization of the Army will take into account the tremendous increase in importance of this logistic area.

A new Deputy Chief of Staff for Logistics is provided who will have charge of the seven Army technical services. It will be his task to develop an integrated Army logistics structure and system which in turn will permit those technical service officers who wish to do so to develop their talents as logistics managers, thus winning promotion and prestige commensurate with the broader usefulness attained.

One major effect of the reorganization, therefore, will be the development of a professional class of officers who will specialize in logistics (design, procurement, and supply) and who will not be drawn from civilian sources but will be regularly produced by the Armed Forces.

In the logistics field there will be a new Assistant Secretary for Logistics. Under him will be the Deputy Chief of Staff for Logistics, in order to bring the civilian and military supply officials into close and responsive relationship.

The Deputy Chief of Staff for Logistics is responsible both to the civilian Assistant Secretary and to the Chief of Staff. The reorganization specifically provides that "if at any time the Chief of Staff finds himself in conflict with the instructions of any of the Assistant Secretaries in the discharge of their responsibilities for functional control, the Secretary or the Under Secretary will resolve them."

STUDENTS who have watched developments in this important field could make one further suggestion. The top-side logistical organization should be kept small. It should have a staff of not more than a dozen or so. In this critical area let there be no empire building. On the contrary, the supply services should be permitted to function with a minimum of interference.

Such students would also urge one final plea: The Deputy Chief of Staff for Logistics should be an officer with at least twenty years of supply service who has also served as chief or assistant chief of one of the supply services. He should have long experience working with industry. He should be a military industrial expert and not a military tactical expert.

Paul L. Davies, chairman of the committee from which this new organization evolved, writing on the subject in the July-August 1954 issue of the *Harvard Business Review*, observes:

"I would like to stress that this proposal envisages a different setup from that of the Army Service Forces organization of World War II which provoked controversy and criticism . . . By contrast, the Supply Command would have a more limited, even though vast, responsibility. Each of the seven technical services would remain for the present a separate operating agency, but each would be aided by a degree of coördinating direction that does not now exist, and each would be fully accountable for performance in a degree that does not now prevail."

It has been stated that there was more matériel in the pipeline at the end of World War II than was used up or shot up or worn out during all the combat operations. The Nation cannot afford this type of wastefulness now—or ever again in the days to come.

New British Matériel

The rotor of the British Fairey Gyrodyne experimental helicopter, above, is powered by compressed air supplied to tip jets through the hollow blades. In cruising, two pusher propellers are used. The new Conqueror tank, below, is powered by a Meteor aircraft engine. It is heavier and mounts a larger gun than any other British tank (British photos).

Reg. U. S. Pat. Off.

INDUSTRIAL PREPAREDNESS

a monthly report on current scientific and logistical developments as they relate to the armament preparedness

This bulletin appears regularly in ORDNANCE. In the months in which the magazine is not published this bulletin is mailed directly to the members of the Technical Divisions and Committees of the Association

No. 95 September 1954

● **The 1954 annual meeting of the Shell Committee** of the Bomb and Artillery Ammunition Division, A.O.A., was held at the Hotel Dennis, Atlantic City, N. J., on June 17 and 18, 1954, under the inspiring leadership of its well-known chairman, Walter N. Howley, president of the Lansdowne Steel & Iron Company, Morton, Pa.

A most informative and interesting agenda had been prepared for this 2-day meeting which developed much valuable discussion by the members of the Committee. Particular attention was devoted to the stand-by programs of the military for storing or maintaining at present locations the manufacturing facilities which had been developed in the recent emergency for the production of artillery shell.

Fortunately Brig. Gen. J. B. Medaris, chief, Industrial Division, Office of the Chief of Army Ordnance, and Capt. W. L. Tann, industrial planning engineer, Navy Bureau of Ordnance, were both present at this meeting to answer questions on this subject.

Another item on the agenda which received considerable attention was the matter of product inspection and quality control in the manufacture of artillery shell, with particular reference to increasing the accuracy of the complete round when fired.

Chairman Howley made a preliminary report of an investigation which he had made (at the request of the Office of the Chief of Army Ordnance) to determine the best recording of the history of shell production during the Korean emergency. He plans to appoint a special subcommittee to investigate this problem further and to submit a report at an early date.

● **With the award of two grants for registration of chemists and engineers** in the United States, the National Science Foundation has launched the first phase of its program to establish a National Register of Scientific and Technical Personnel.

Registration of chemists will be undertaken by the American Chemical Society, Washington, D.C., which will send out registration questionnaires to an initial list of 50,000 American chemists. Registration information on each individual will include name, address, education, chemical specialty, and current employment.

Information will be kept current by the society. Duplicate copies of the information will be made available to the Foundation for statistical studies and to assist in the mobilization of scientists in time of war. The information will not be used normally for employment or placement of scientists.

The registration of engineers will be conducted by the Engineers' Joint Council, New York, N. Y. At present, no attempt will be made to obtain registration information on all the estimated 500,000 engineers in the United States. The engineering section of the Register will be limited to about 20,000 leaders in all engineering fields.

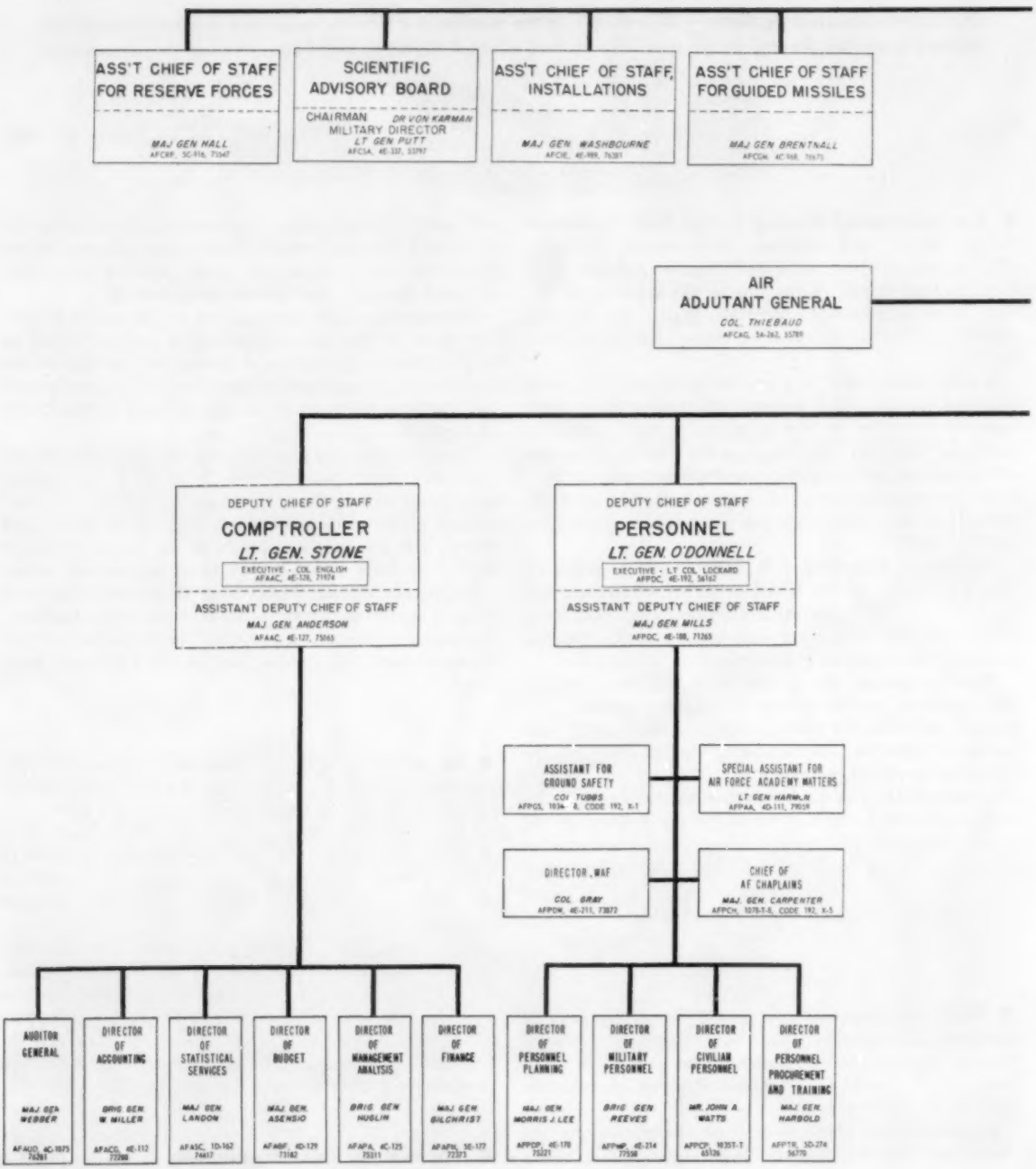
Experience during World War II indicates that such a list of leaders may provide an effective means for locating engineers for special projects. The engineers' list will be maintained on a current basis by the Engineers' Joint Council.

● **An Industry Advisory Committee** which will map recommendations for the disposal of military surplus matériel was recently organized. This group is a joint committee of the Defense Department and the General Services Administration under the chairmanship of Albert B. Drake, Director of Storage, Distribution, and Disposal in the Office of the Assistant Secretary of Defense (Supply and Logistics).

It is contemplated that the military services will delay the future sales of surplus goods which may have an adverse effect on the commercial market until the Business and Defense Services Administration has had an opportunity to make technical recommendations. The new instructions to be issued by the Department of Defense will provide for greater publicity for surplus sales.

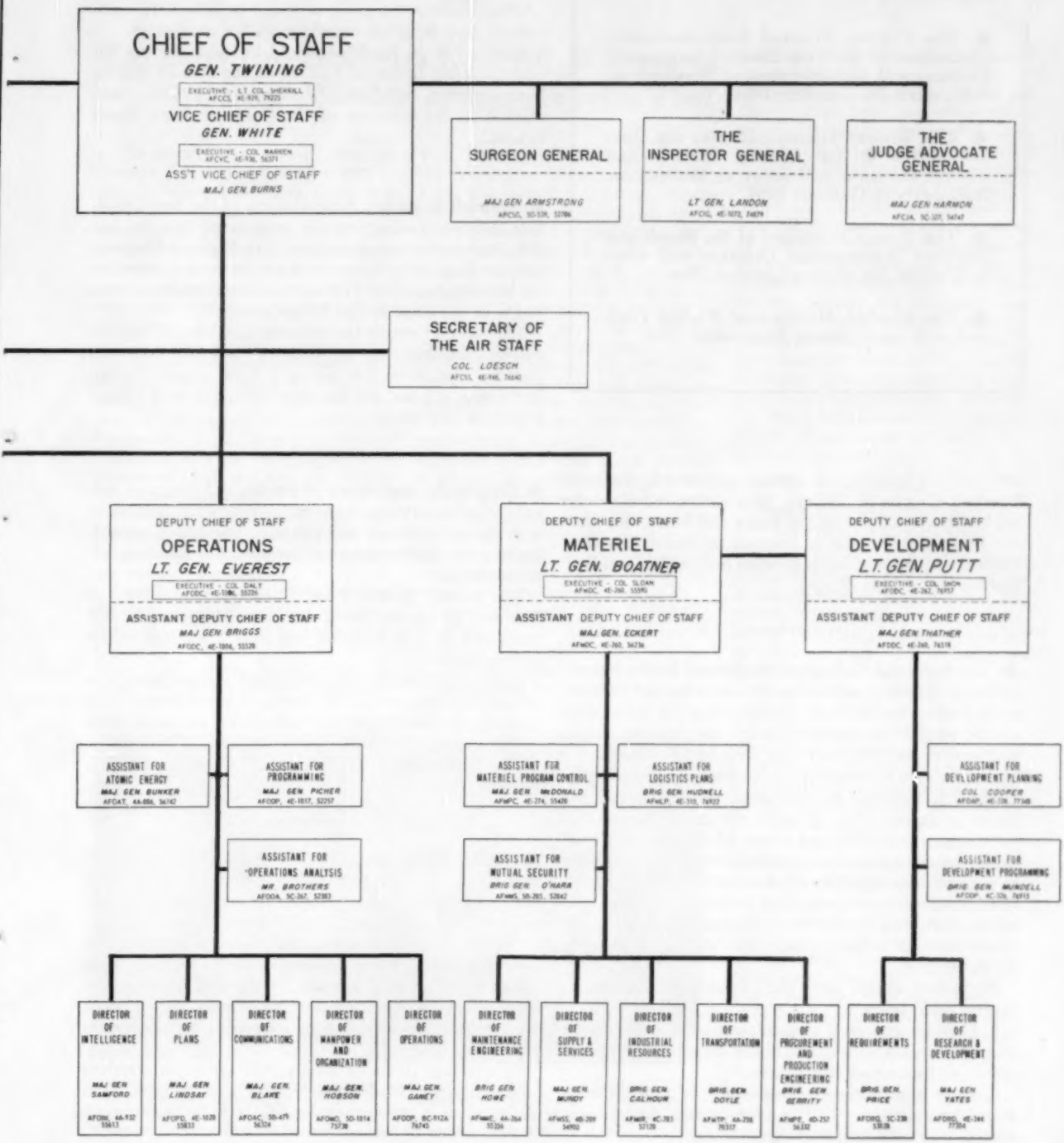
● **The new Air Force organization** shown on pages 2

THE AIR STAFF,



Compiled as of June 1954

U. S. AIR FORCE


CHIEF OF STAFF
GEN. TWINING
EXECUTIVE - LT. COL. SHERRILL
AFCCS, 4E-929, 79225
VICE CHIEF OF STAFF
GEN. WHITE
EXECUTIVE - COL. WARREN
AFCVC, 4E-936, 56371
ASS'T VICE CHIEF OF STAFF
MAJ GEN. BURNS
SURGEON GENERAL
MAJ GEN. ARMSTRONG
AFCSG, 5D-539, 52786
THE INSPECTOR GENERAL
LT GEN. LANDON
AFCIG, 4E-1072, 76879
THE JUDGE ADVOCATE GENERAL
MAJ GEN. HARMON
AFCJA, 5C-329, 56743
SECRETARY OF THE AIR STAFF
COL. LOESCH
AFCSS, 4E-946, 76640
DEPUTY CHIEF OF STAFF
OPERATIONS
LT. GEN. EVEREST
EXECUTIVE - COL. DALY
AFODC, 4E-1006, 55226
ASSISTANT DEPUTY CHIEF OF STAFF
MAJ GEN. BRIGGS
AFODC, 4E-1006, 55226
DEPUTY CHIEF OF STAFF
MATERIEL
LT. GEN. BOATNER
EXECUTIVE - COL. SLOAN
AFMDC, 4E-260, 55590
ASSISTANT DEPUTY CHIEF OF STAFF
MAJ GEN. ECKERT
AFMDC, 4E-260, 56236
DEPUTY CHIEF OF STAFF
DEVELOPMENT
LT GEN. PUTT
EXECUTIVE - COL. SHON
AFDDC, 4E-262, 76957
ASSISTANT DEPUTY CHIEF OF STAFF
MAJ GEN. THATHER
AFDDC, 4E-260, 76519
ASSISTANT FOR ATOMIC ENERGY
MAJ GEN. BUNKER
AFOAT, 4A-886, 56742
ASSISTANT FOR PROGRAMMING
MAJ GEN. PICHER
AFOOP, 4E-1017, 52257
ASSISTANT FOR OPERATIONS ANALYSIS
MR. BROTHERS
AFOOA, 5C-267, 52383
ASSISTANT FOR MATERIEL PROGRAM CONTROL
MAJ GEN. McDONALD
AFMPC, 4E-274, 55420
ASSISTANT FOR LOGISTICS PLANS
BRIG GEN. HUDNELL
AFMLP, 4E-333, 76922
ASSISTANT FOR MUTUAL SECURITY
BRIG GEN. O'HARA
AFMMS, 5D-285, 52842
ASSISTANT FOR DEVELOPMENT PLANNING
COL. COOPER
AFDAP, 4E-126, 77348
ASSISTANT FOR DEVELOPMENT PROGRAMMING
BRIG GEN. MUNDELL
AFDDP, 4C-526, 76915
DIRECTOR OF INTELLIGENCE
MAJ GEN. SAMFORD
AFOIN, 4A-932, 55613
DIRECTOR OF PLANS
MAJ GEN. LINDSAY
AFOPD, 4E-1028, 55833
DIRECTOR OF COMMUNICATIONS
MAJ GEN. BLAKE
AFOAC, 5D-479, 56304
DIRECTOR OF MANPOWER AND ORGANIZATION
MAJ GEN. HOBSON
AFOMO, 5D-1014, 75738
DIRECTOR OF OPERATIONS
MAJ GEN. GAMEY
AFOOP, 5C-912A, 76745
DIRECTOR OF MAINTENANCE ENGINEERING
BRIG GEN. HOWE
AFMMC, 4A-264, 55326
DIRECTOR OF SUPPLY & SERVICES
MAJ GEN. MUNDY
AFMSS, 4B-209, 54900
DIRECTOR OF INDUSTRIAL RESOURCES
BRIG GEN. CALHOUN
AFMIR, 4C-781, 52128
DIRECTOR OF TRANSPORTATION
BRIG GEN. DOYLE
AFMTP, 4A-226, 76317
DIRECTOR OF PROCUREMENT AND PRODUCTION ENGINEERING
BRIG GEN. GERRITY
AFMPE, 4D-257, 56332
DIRECTOR OF REQUIREMENTS
BRIG GEN. PRICE
AFDRQ, 5C-238, 53828
DIRECTOR OF RESEARCH & DEVELOPMENT
MAJ GEN. YATES
AFDRD, 4E-344, 77304

MEETINGS OF NATIONAL TECHNICAL DIVISIONS AND COMMITTEES OF THE AMERICAN ORDNANCE ASSOCIATION

● **The Welding Committee of the Advisory Technical and Research Group will meet at Washington, D.C., on Thursday, September 9, 1954.**

● **The Proving Ground Instrumentation Committee of the Fire Control Instrument Division will probably meet at Washington, D.C., during September 1954.**

● **The Rocket Committee and the Jato Committee of the Guided Missile and Rocket Division will meet at Wallington, N.J., early in October 1954.**

● **The Fuze Committee of the Bomb and Artillery Ammunition Division will meet in Chicago, Ill., during October 1954.**

● **The Guided Missile and Rocket Division will meet during November 1954.**

and 3 of this bulletin was recently approved by Defense Secretary Charles E. Wilson, who authorized its early implementation. As with the Army and Navy, this new Air Force organization is designed to complement the Defense Department reorganization ordered by President Eisenhower in June of 1953.

● **The Industrial College of the Armed Forces** has established a correspondence study course for the purpose of extending the facilities of the college to those who cannot receive instruction through the resident course and who in an emergency may serve in key positions in the military, in Government, or in civilian economy.

Regular, Reserve, and National Guard officers, on active- or inactive-duty status in the grade of major or lieutenant commander and above, of all components of the Department of Defense and the Coast Guard; civilians of Government agencies of comparable status; executives of industry, educators, and prominent citizens who in an emergency may serve in comparable positions in Government or in the civil economy are eligible to apply for the course.

Applicants should meet one or more of the specific criteria listed below:

1. Hold an important civilian position in some field of endeavor which would contribute toward the national objectives in time of emergency.

2. Have a mobilization assignment to a major command headquarters or to an organization directly concerned with economic mobilization.

3. Have attended a National Resources Conference (formerly referred to as the Field Economic Mobilization Course) conducted by the Industrial College of the Armed Forces.

4. Have completed major courses of high level in own service.

5. Have a college education or the equivalent.

6. Have attained important command, staff, or operational assignment.

Officers below the grade of major or lieutenant commander may be given consideration for enrollment.

Application or inquiries should be submitted to the Commandant, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington 25, D.C., and marked to the attention of the Correspondence Study Branch.

● **Wendell B. Barnes,** Administrator of the Small Business Administration, recently announced that he has delegated authority to the agency's 14 Regional Directors to make loans up to $50,000 without the prior approval of the Washington office. Previously, all small business loans had to be approved by the Administrator.

This action permits the regional directors to approve participation loans up to $50,000 to any one borrower provided that a bank is taking at least a quarter share in the loan and that not less than half of the bank's share represents new money.

● **Despite the importance of patents** and the great volume of patent activity, many businessmen are unfamiliar with patent protection and patenting procedures, according to a new leaflet announced by the Small Business Administration.

The leaflet, "Know Your Patenting Procedures," is Number 49 in the Small Business Management Aid series and may be obtained free from SBA regional or branch offices.

Basic facts about patenting and details of patenting procedures are explained in the leaflet. A breakdown distinguishing features or patents, trademarks, and copyrights, and an explanation of the method of applying for a patent to the Commissioner of Patents, Washington 25, D.C., are also given.

● **Publication of the U.S. Government Purchasing Directory,** the first complete guide to military and civilian purchasing activities of the Federal Government, was announced recently by the Small Business Administration.

The directory lists some 4,000 classes of commodities covering the more than 5,000,000 items purchased by both military and civilian agencies of the U.S. Government and makes it easy for the businessman to learn who in the Federal Government, biggest buyer in the world, buys what—and where.

The 92-page directory is on sale by the Superintendent of Documents, Washington 25, D.C., for 50 cents. It is designed as a companion to SBA's U.S. Government Specifications Directory.

ASSOCIATION AFFAIRS

Capacity Crowd Hears General O'Donnell Address Meeting of Los Angeles Post

The annual dinner meeting of the Los Angeles Post was held on June 25th at the California Club where about four hundred members gathered to greet Lieut. Gen. Emmett O'Donnell, Jr., Deputy Chief of Staff for Personnel, U.S.A.F., the guest of honor. The capacity crowd of members and guests assembled in the club's spacious main room for a reception prior to the dinner.

R. C. Geffs, president of the vigorous Los Angeles Post, opened the meeting with the pledge of allegiance to the Flag. After an excellent dinner Mr. Geffs announced the new Post directors and introduced the toastmaster, K. T. Norris, a regional vice-president of the American Ordnance Association and president of Norris-Thermador Corporation.

Mr. Norris in turn praised Mr. Geffs for the outstanding success of the Los Angeles Post and introduced the following guests on the dais:

Capt. J. S. Laidlaw, U.S.N., Inspector of Naval Material, and Mrs. Laidlaw; James Bone, president of the Los Angeles Chamber of Commerce, and Mrs. Bone; Capt. H. F. Stout, U.S.N., Chief of Staff, 11th Naval District; Lieut. Col. R. F. Pike, Assistant Chief, Los Angeles Air Procurement District, and Mrs. Pike; Lieut. Col. Joseph E. Johnston, Deputy District Chief of Ordnance; Henry L. Clark, a national director of the A.O.A., and Mrs. Clark; Mrs. K. T. Norris, Mrs. R. C. Geffs, and Mrs. H. O. Eaton, Jr.

A message from Lieut. Gen. L. H. Campbell, Jr., president of the A.O.A., was delivered by Capt. J. M. P. Wright from Association headquarters.

Mr. Norris called on Bob Geffs to introduce Maj. Gen. Homer O. Eaton, Jr., commanding general, 40th Division, California National Guard. The General recounted many of the exploits in Korea where his division relieved the 24th Division in a key position on the line. Although not permitted to advance, they never lost ground in the face of Red attacks. He told how his division was still using World War II tanks and vehicles from those rehabilitated by the Tokyo Ordnance District.

General O'Donnell, after a sparkling introduction by Mr. Norris, delivered an impressive talk on the problems we face to have "peace in our time" and the spiritual and physical measures that the United States can take to maintain an armed peace.

The general realistically pointed out that we cannot expect to eliminate war as long as the ravaging hordes of Communism exist and that consequently we must be willing to fight and maintain our fighting equipment to keep our freedom.

Five additional members of the Post's board of directors recently were elected by mail ballot. They are: Gen. Omar N. Bradley, Aerojet General Corporation, Azusa, Calif.; Gordon Crary, E. F. Hutton & Company, Los Angeles; Leslie Hoffman, Hoffman Radio Company, Los Angeles; William B. McGee, Hughes Tool Company, Houston, Tex., and W. E. Zander, Rheem Manufacturing Company, South Gate, Calif. Morris Pendleton, Plomb Tool Company, Los Angeles, was elected to serve out the term of Walter Main, resigned.

Attending Los Angeles Post meeting were, left to right, K. T. Norris, Lieut. Gen. Emmett O'Donnell, Jr., Col. J. E. Johnston, F. W. Conant, R. C. Geffs, Maj. Gen. H. O. Eaton, Jr., and Capt. H. F. Stout, U.S.N. General O'Donnell, Deputy Chief of Staff for Personnel, U.S.A.F., was the guest of honor at the meeting.

PHILADELPHIA POST HOLDS MEETING ABOARD SHIP

One of the most instructive and enjoyable meetings in the history of the American Ordnance Association was held June 24, 1954, when members of the Philadelphia Post were privileged to visit the great Fairless Works of the United States Steel Corporation.

It was a day-long program which started at 9:30 a.m. when 700 members of the Post, led by Jared Ingersoll, a national director of the Association, boarded a specially chartered steamer at the foot of Chestnut Street, Philadelphia, for the journey up the Delaware River to the plant and return.

The weather was ideal—typical A.O.A. weather, indeed—and the journey by boat was thoroughly enjoyable. Guests were instructed by loud-speakers about the industrial establishments on both sides of the Delaware as the journey progressed, and later the beautiful countryside on the Pennsylvania and the New Jersey shores elicited much favorable comment.

The meeting was planned by the retiring president of the Post, Col. Albert W. Gilmer, and his colleagues. He was given a rising vote of thanks later in the day, not only for his leadership of the Post but for this climax which proved to be such a happy occasion for all.

At 10:30 a.m., aboard ship, the annual meeting of the Post was held at which William H. Worrilow, president of Lebanon Steel Foundry, Lebanon, Pa., was installed as president to succeed Colonel Gilmer. Other speakers at the meeting were Maj. Gen. William D. Eckert on behalf of the United States Air Force, and Col. Leo A. Codd, executive vice-president of the Association.

Following the meeting a buffet luncheon was served aboard.

Upon the arrival at the Fairless Works the party boarded special buses for the plant tour. Under the guidance of Albert Berdis, general manager of the plant, representing Benjamin F. Fairless, chairman of the corporation, members were privileged to see the newest and most complete steel plant in the world today.

The tour included all the principal operations from the unloading of the ore at dockside to the most modern rolling mill. Guests were deeply impressed by the efficiency of the establishment and its significance for the national strength of our country, both in the development of peacetime products and interests as well as defense needs.

Officials of the plant were generous in their hospitality and in making available to their guests complete descriptions of the various facilities and techniques used in modern steelmaking.

At 4:30 p.m. the delegation boarded the steamer for the return journey down the Delaware to Philadelphia. Refreshments were served aboard during the return trip. The group arrived at the dock in Philadelphia on schedule at 6:30 p.m. loud in its praise of the plant, the accommodations aboard ship, and the pleasant atmosphere provided by the method of transportation.

At the business meeting in the morning expressions of thanks to the U. S. Steel Corporation were made on behalf of the Philadelphia Post by Al Gilmer and Bill Worrilow, and on behalf of the national organization by Colonel Codd.

In accepting the presidency of the Post Mr. Worrilow took as his keynote his endeavor to make the Post a strong factor in the progress of the industrial area along the Delaware River as an element of our national-defense plans. On this point he stated:

"From time immemorial we have had a Delaware River, but only for a few years have we had a Fairless Steel Works at Morrisville, Pa.

"I was working in Pittsburgh when the Steel Corporation was formed and well remember how skeptical every one was of its success and speculated as to how such an apparently unwieldy group could be made to work efficiently and economically.

"Such people thought only of buildings, equipment, mines, railroads, steamship lines, etc. They overlooked entirely the other member of the body—management.

"You are familiar with the history of that management, and as the able men of those days laid the broad base for the successful operation of the corporation, there was one phase they emphasized, and that was the training of their successors. So today the same courage, good judgment, and tenacity of purpose displayed by the founders in forming the organization are displayed by the present heads of this same great organization.

"The establishment of this plant started a chain of new plants along the Delaware that lengthens year after year and is composed of every type of industry, thus making our river a replica of the Rhine or the Clyde with their numerous towns, industries and water-borne freight.

"May we, with other custodians of the Valley, be faithful to our trust and discharge our duties with fidelity and honor and pass on to our successors a Post worthy of its traditions and enriched and strenghthened by the effort we have put into it."

Mr. Worrilow and Colonel Gilmer were given standing votes of appreciation by all members present. The following vice-presidents of the Post also were elected to serve with Mr. Worrilow:

Henry W. Gadsden, vice-president, Sharp & Dohme, Philadelphia; Joseph H. Gillies, vice-president, Philco Corporation, Philadelphia; Howard S. Lewis, president, Parish Pressed Steel Company, Reading, Pa.; Walter C. Pew, director, Sun Oil Company, Philadelphia.

The following directors also were elected: Robert H. Andrews, Philco Corporation, Philadelphia; Edward G. Budd, Jr., president, the Budd Company, Philadelphia; Arthur Sinkler, president, Hamilton Watch Company, Lancaster; Lewis M. Parsons, vice-president, East U. S. Steel Corporation, Philadelphia; William P. Drake, vice-president, Pennsylvania Salt Manufacturing Company, Philadelphia; Colonel Gilmer, Philadelphia.

• **AT EGLIN AIR FORCE BASE.**—The Florida Post held its final dinner meeting of the year on Monday, July 14th, at the new Fort Walton Beach Yacht Club. The guest of honor and principal speaker was Dr. Ralph C. Swann, assistant director of the Ordnance Missile Laboratories of Redstone Arsenal, Huntsville, Ala.

Dr. Swann discussed the organization and history of the arsenal and its record of service to the Air Force. His talk was of intense interest to the members and guests at this meeting as most of them are actively engaged in aircraft weapons testing and development.

Air Force Establishes Liaison Committee To Foster Coöperation with the A.O.A.

The American Ordnance Association deeply appreciates a recent move by the U. S. Air Force in establishing a Liaison Committee under the guiding hand of

General Eckert **General Boatner**

Lieut. Gen. B. L. Boatner, Deputy Chief of Staff, Matériel, in order to further the close coöperation between this great service and the members of the Association.

General Boatner and his deupty, Maj. Gen. W. D. Eckert, have indicated their intention of taking a personal interest in the affairs of the Association.

Under the chairmanship of Col. R. W. Green in the Office of the Director of Industrial Resources are the following officers of the Committee:

Col. J. T. McKee, Office of the Director of Procurement and Production Engineering.

Col. R. L. Johnston, technical executive, Office of the Director of Research and Development.

Col. R. A. Soukup, Office of the Director of Research and Development.

Lieut. Col. Gerald Couch, Office of the Director of Supply and Services.

Lieut. Col. W. L. Helmantoler, Special Assistant for Deputy Chief of Staff, Matériel, committee secretary.

A meeting of the headquarters staff of the Association and the Liaison Committee was held in Washington on July 27th at which ways were discussed for increasing the assistance that the American Ordnance Association might give in the industrial field to the personnel of the Air Force who are responsible for armament. Tentative plans have been formulated, and their implementation will begin shortly.

Michigan Post Sponsors Exhibition and Seminar on the Uses of Atomic Energy

At Detroit the Michigan Post showed masterful community leadership in presenting to its members the significant advances that have been made in this country in utilizing nucleonics. A restricted showing of an exhibit of the many applications of atomic energy for industrial and biological uses held for members on June 9th was followed by two days of public showing sponsored by the Michigan Post.

On June 9th the exhibition was followed by a large dinner for A.O.A. members and guests where an impressive panel of speakers discussed the various ways in which our knowledge of nuclear physics is employed.

Over 750 members and guests assembled in the Fountain Room of Detroit's Masonic Temple to hear the latest on atomic-energy uses. C. L. Jacobson, Post president, presiding, welcomed new members to the A.O.A. and introduced the Post officers and directors at the speakers' table. He paid special tribute to James K. Fulks, chairman of the Activities Committee, who arranged the excellent program, and to F. Russell Valpey, chairman of the Membership Committee, who has been waging a successful campaign to bring in more members, and then introduced Robert L. Biggers, a national vice-president of the Association and a former president of the Michigan Post.

Mr. Biggers introduced Rear Adm. George C. Wright, director, Atomic Energy Division, Office of the Chief of Naval Operations, who explained that in addition to the awesome weapons derived from nuclear fission and fusion there are equally useful atomic power plants being developed for military use. He stated that present successes are so encouraging that the Navy will request Congress to authorize two faster and more powerful submarines with atomic power plants. Admiral Wright's remarks are published in full on page 224 of this issue.

W. L. Cisler, president, Detroit Edison Company, was called upon to introduce H. N. Muller, assistant engineering vice-president of Westinghouse, who presented a clear picture of the disparity between available energy sources and future requirements for power. He showed that atomic power plants will be essential to balance the discrepancy. He utilized a spectacular set of tripanoramic slides in color to emphasize his discussion.

Mr. Muller was followed by Dr. Henry Romberg, professor at the University of Michigan and assistant director of the Phoenix Project, a Detroit-supported project to explore peacetime uses of atomic energy.

Dr. Romberg related recent specific findings in combating trichinosis made possible through radioactive-tracer techniques and described the remarkable molecular changes in plastics exposed to radioactivity.

Dr. L. R. Hafstad, director of the Reactor Division, Atomic Energy Commission, closed the seminar with a neat summary of the types of problems involved in perfecting commercial atomic power plants. He emphasized the amazing flexibility of nuclear fission wherein it can be forced to react rapidly to give an atomic bomb explosion or slowly to produce power.

The Michigan Post is to be congratulated on providing its members with such complete coverage of atomic-energy developments in this country outside of the highly classified weapons field.

TWO GOLF TROPHIES DONATED TO THE WASHINGTON POST

Two trophies for golf players were established last fall under the banner of the A.O.A. Through the good offices of Col. Ludlow King, Fred T. Marshall, and other leaders in the Washington Post, both B. F. Fairless, president of United States Steel Corporation, and John L. McCaffrey, president of International Harvester Company, donated large sterling-silver bowls for competition trophies in the A.O.A. golf tournament sponsored annually by the Washington Post. The tournament is open to all A.O.A. members.

The Benjamin F. Fairless Trophy for the champion golfer, low gross, was presented by Mr. Fairless, a national director of the A.O.A., a staunch supporter of the Association for many years, and a proponent of industrial preparedness.

Mr. Fairless has managed the vast enterprises of the United States Steel Corporation for over fifteen years after he was at the helm of the Union Alloy, Republic, and Carneigie-Illinois Steel companies in that order. He is a member of several country clubs where he is an enthusiastic golfer and shoots a good game.

R. H. Rife, left, receives the Benjamin F. Fairless Trophy from Mr. Fairless.

The John L. McCaffrey Trophy, for low net, was donated by Mr. McCaffrey, active in affairs of the Chicago Post and who, as an executive of International Harvester Company, has for many years directed a large volume of ordnance and other defense production. Mr. McCaffrey started his industrial career with International Harvester in 1909, being elected president in 1946, after serving since 1941 as a vice-president and director of the company.

The McCaffrey Trophy is for competition among A.O.A. members and guests, the Fairless Trophy is open to A.O.A. members only, from any part of the country. The winner of each trophy retains the big silver bowl until the next tournament and is presented with a miniature trophy he may keep.

Last year the Fairless Trophy was won by R. H. Rife of Hubeny Corporation, the McCaffrey Trophy by James C. Coffman of Coffman and Hoagerty. This

J. C. Coffman and the McCaffrey Trophy.

John L. McCaffrey, the donor.

year the Washington Post has already selected Wednesday, October 6th, as Tournament Day at the Army-Navy Country Club. All golf-playing members who can make Washington at that time should apply to A. H. Hobelmann, Walter Kidde & Company, Mills Building, Washington 6, D. C., for a starting time and pairing. He is general chairman for the meeting, assisted by George E. Engleman, Studebaker Corporation, Prize Committee, and by Ralph Deeber, Allis-Chalmers Manufacturing Corporation, Golf Committee.

After golf, refreshments, and dinner, there will be a drawing for the many magnificent door prizes donated by friends of the American Ordnance Association.

The fee for all activities—golf, refreshments, and dinner—will be $12.

Capital Cities Post Hears Captain Reamy Speak on Industrial Support for the Navy

The Capital Cities Post held its fourth and last meeting of the year at the Circle Inn, Lathams, N. Y. The members and guests assembled to hear Capt. T. G. Reamy, U.S.N., naval inspector of machinery and ordnance at the General Electric Company, speak on "Fleet Support in the Electromechanical Age."

Vice Adm. W. A. Kitts presided as Post president for the last time, turning over the helm during the meeting to Earl D. Rhodes, vice-president of Kenwood Mills, Rensselaer. The members hailed both the new and retiring presidents with a standing round of applause.

In his address Captain Reamy discussed the complicated spare-parts problem in the modern Navy where, for example, the number of Diesel engines in use have multiplied one hundred times in the past ten years. He described how the use of landing ships as supply centers for technical spare parts has greatly simplified the issue of such items to our fleet.

He also touched a point very near to many of the industrialists present when he gave accounts of his personal experiences on the receiving end of improper packaging of military items.

This Post recently joined the increasing number of Posts which annually present awards to outstanding students in R.O.T.C. units of local colleges or universities. Capital Cities has founded, by special subscription of the members under the leadership of Admiral Kitts, the "Capital Cities Post A.O.A. Medal."

Vice Adm. W. A. Kitts, left, retiring Post president, about to turn gavel over to E. D. Rhodes, right, the incoming executive.

The first presentation was made to Cadet Maj. Alexander J. Glass, a senior at Rensselaer Polytechnic Institute. The presentation was made by President-elect Rhodes in the absence of Admiral Kitts.

Tri-Cities Chapter Inducts Officers, Hears Talks, Views Films at Meeting

The Tri-Cities Chapter of the Empire Post held its spring dinner meeting on May 28th at the American Legion Hall in Vestal, N. Y., where new officers of the Chapter were inducted. Chairman Michael J. Lawlor, Ansco Corporation, Binghamton, N. Y.; Vice-Chairman Charles F. McElwain, International Business Machines Corporation, New York, N. Y.; and Secretary-Treasurer John H. Bouman, Ansco Corporation, Binghamton, N. Y., will direct the operations of this active Chapter for the coming season.

About sixty members and guests assembled for the reception and dinner where Ray C. Malvin, president of the Empire Post, was the guest of honor. Mr. Lawlor presided at the speakers' table and after a brief business meeting introduced the distinguished guests: Gwyn Thomas, Manufacturers Association, Syracuse, N. Y., and also national member of the A.O.A. Council for the Empire Post; Capt. Anthony Skotnicki, U.S.M.C.; and Capt. Frank J. Buran, U.S.M.C.

Mr. Malvin congratulated the new officers of the Tri-Cities Chapter and praised the Post for its splendid achievements in more than doubling its membership since reactivation in February. He described industrial progress in upper New York State and the part the Association has played in developments in the area. Mr. Thomas spoke on the aims and purposes of the American Ordnance Association.

After these talks two films entitled "Iwo Jima" and "With the Marines at Chosin-Hungnam" were shown through the courtesy of the local Marine Corps Reserve Unit. Captain Buran, who was engaged in both actions, gave a running commentary which contributed immensely to the interest of these pictures.

The International Business Machines Corporation's film, "Piercing the Unknown," showed the members some of the latest tricks in electronics that may be applied to computing machines of the future.

The keen interest in Association affairs shown by the members of this small Chapter is outstanding. They merit the applause of the entire membership for enthusiastic coöperation in furthering the aims and purposes of this organization.

• **AT ROCHESTER.**—The board of directors of the Empire Post met on May 25th to receive reports and elect new officers for the 1954-1955 season. The secretary reported a net increase of 172 members, a present total of 1,285. Large gains were made in the Tri-Cities, Syracuse, Rochester, and Frontier Chapters.

Carl S. Hallauer, Post president, declined nomination for reëlection. The following officers were elected:

President, Ray C. Malvin, U.S. Hoffman Machinery Corporation, Auburn, N. Y.;

First vice-president, Francis R. Gorman, Gorman & Halpern, Utica, N. Y.;

Second vice-president, Michael J. Lawlor, Ansco Corporation, Binghamton, N. Y.;

Treasurer, Raymond M. Biehler, Rochester Institute of Technology, Rochester, N. Y.;

Secretary, Col. Edward G. Miller, Rochester Ordnance District, Rochester, N. Y.;

Assistant secretary, Ethel E. Henschel, Rochester Ordnance District, Rochester, N. Y.;

National Council representative, E. Gwyn Thomas, Manufacturers Association of Syracuse, Syracuse, N. Y.

The following new directors also were elected: Ralph F. Peo, Frontier Industries, Inc., Buffalo, N. Y.; Lyman K. Stuart, C. H. Stuart & Company, Newark, N. J.; and Douglas B. Whitney, Harrison Radiator Corporation, Lockport, N. Y.

The meeting closed after plans were

made for an annual dinner meeting to be held in the fall in Buffalo where the Post has one of its most active units—the Frontier Chapter.

• **AT OMAHA.**—At a recent meeting of the Nebraska Post of the A.O.A., the following officers were elected:

President, Dana C. Bradford, Bradford-Kennedy Company, Omaha, Nebr.;

Vice-president, Robert Bernstein, Independent Metals Company, Omaha, Nebr.;

Secretary-treasurer, Fred G. Arkoosh, Wilkinson Manufacturing Company, Omaha, Nebr.

The following directors, also were elected: Robert Ammon, Cushman Motor Works, Inc., Lincoln, Nebr.; Frederick Bucholz, Omaha Steel Works, Omaha, Nebr.; Clyde B. Dempster, Dempster Mill Manufacturing Company, Beatrice, Nebr.; Burr Hughes, Hughes Brothers, Seward, Nebr.; John McCague, Jubilee Manufacturing Company, Omaha, Nebr.; Karl Vogel, Nebraska State Senator, Omaha, Nebr.; Keith Waugh, Meade Ordnance Plant, Wahoo, Nebr.

• **BRIG. GEN. WILLIS R. SLAUGHTER,** commanding general of the Ordnance Training Command, Aberdeen Proving Ground, Md., retired from the Army on June 30, 1954, after more than 41 years of active service. The major portion of General Slaughter's military career was with the Ordnance Corps of the Army where he always helped to maintain the close relationship between industry and Army Ordnance through the American Ordnance Association.

• **CLARENCE WORTHINGTON HAMILTON,** a life member of the American Ordnance Association and one of its most active and valiant supporters, died at Little Current, Ontario, June 7, 1954. He was public-relations director and administrative staff member of Sheffield Corporation, Dayton, Ohio.

Mr. Hamilton was a native of Franklin, Ohio. He joined the Sheffield organization eleven years ago, leaving the post of public-relations director for the Globe-Wernicke Company, Cincinnati. Preceding that he had been associated with the late John H. Patterson, founder of the National Cash Register Company, Dayton, and later with the Firestone Rubber Company.

Mr. Hamilton was awarded life membership in the American Ordnance Association in 1952. At the time of the membership award he was praised by Louis Polk, president of Sheffield and a vice-president of the American Ordnance Association, for his ability to "get things done, to button things up."

Mr. Hamilton gave unstintingly of his service to the national headquarters staff of the A.O.A. to whom his kindly and most capable counsel was of inestimable value. Especially in connection with the historic annual meeting of the Association at Cincinnati and Wright-Patterson Air Force Base in 1951, Mr. Hamilton was the guiding star and energetic director of the entire public-relations assignment of that meeting.

Through his wide acquaintance and great ability the 1951 Annual Meeting surpassed all others in the history of the Association in its coverage by television, radio, and the press. The record-breaking attendance at the meeting both in Cincinnati and at Wright Field was in large measure due to the selfless devotion of Clarence Hamilton to every detail of the operation, so characteristic of his talent for organization.

In the passing away of this talented gentleman, the American Ordnance Association has lost one of its main supporters whose name seldom appeared in the headlines—in keeping with his humility—but whose flawless guidance was responsible for many A.O.A. successes in recent years to a degree beyond evaluation.—L. A. C.

• **MAJ. GEN. FRANK R. McCOY,** long an intimate friend of the founders of the Ordnance Association and himself a distinguished military leader over many years of American history, died in Washington on June 4, 1954. He was a graduate of the United States Military Academy, Class of 1897, and served with the 8th U. S. Cavalry until the outbreak of the Spanish-American War.

In 1900 he became aide-de-camp to Maj. Gen. Leonard Wood, Military Governor of Cuba, and in 1906 he was selected to serve as military aide to President Theodore Roosevelt. He was detailed to the General Staff Corps in 1911 and later, as chief of staff of the Brownsville Texas District, helped direct the mobilization of the National Guard on the Mexican Border.

In World War I General McCoy was Director General of Transportation at Tours, France. Following that conflict he served on a number of military-diplomatic missions and later was in command of the IV Corps Area, Atlanta, and of the Second Army and VI Corps Area at Chicago. At the time of his retirement in 1938 he was commanding general of the II Corps Area at Governors Island.

General McCoy was a close associate of the late Brig. Gen. Benedict Crowell, first president of the Ordnance Association, and of Maj. Gen. C. C. Williams, also one of the Association's founders.

• **FLOYD E. HAUSS,** president of Hauss & Company, Norwood, Ohio, and long a member of the American Ordnance Association, died at Cincinnati on May 30, 1954. He was an active member of the Association's Cincinnati Post and the father of Maj. Thomas E. Hauss of the Ordnance Corps, U. S. Army.

A native of Ohio, Mr. Hauss was a pioneer in the automotive industry. He started his own automotive electrical shop in Norwood following the First World War. His activities expanded over the years until he became one of the leading automotive jobbers in the Cincinnati area. He was also an active member of the Institute of Electrical Engineers.

• **CAPT. JOHN O. HUSE,** U.S.N., Ret., vice-president and sales manager of Chrysler Motor Parts Corporation and an active member of the American Ordnance Association, died at Detroit on June 28, 1954. He retired from active service in the Navy in 1947.

Captain Huse was graduated from the U. S. Naval Academy in 1919 and thereafter much of his naval service was devoted to submarine improvements, particularly in the field of Diesel engines. In World War II he was on duty in the European theater where he saw action with an Allied Commando unit. Transferred to the Pacific theater, Captain Huse was placed in charge of spare-parts distribution for the entire theater. He received the Navy Bronze Star at the conclusion of his active service.

• **CAPT. MERLE A. SAWYER,** U.S.N., Ret., died suddenly May 24th, in the Naval Medical Center, Bethesda.

A native of Woodstock, Vt., Captain Sawyer was graduated from the Naval Academy in 1924. He served in the battleship UTAH and in the aircraft tender WRIGHT and at the time of the Japanese attack on Pearl Harbor was assistant gunnery officer on the staff of Admiral Nimitz. He served as commanding officer of the antiaircraft cruiser RENO and was operations officer with the Atlantic Fleet in 1946.

All of Captain Sawyer's shore assignments were in Bureau of Ordnance activities where he served during part of World War II as chief of the Procurement Section for Ammunition. During this assignment he controlled procurement in the proximity-fuze program and was in charge of designs, tests, and distribution of rockets and rocket components.

From 1950 until his retirement in 1952 Captain Sawyer was head of the Shore Establishment Division of the Bureau of Ordnance where he directed the activities of all ammunition depots and naval ordnance plants.

For many years Captain Sawyer was a strong supporter and good friend of the American Ordnance Association. He helped greatly to cement good relations between Naval Ordnance and industry.

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MATERIALS PROGRESS

George S. Brady

Synthetic Mica.—Natural electrical-grade mica, which has long been rated as a scarce strategic material, may soon be replaced by synthetics that can be had in dependable quantities by continuous production methods. Mica is a common mineral, but less than ten per cent of the mica mined falls into the class of electrical grade, and only a small fraction of that ten per cent is finally separated out as high-grade sheet suitable for electronic insulation.

The labor involved in splitting the mineral into thin film, grading, and testing for iron spots and other impurities that injure the electrical properties is enormous. Moreover, even the best natural mica films are likely to have waves, ridges, and variations in thickness that cause troubles in delicate electronic components.

Toward the end of World War II the Germans succeeded in producing mica by application of heat and pressure to selected compositions of minerals. The Bureau of Mines took up the work in this country in an attempt to perfect the process, select a composition that would give the highest insulating value, and reduce the cost.

Basing operations on what has been learned from the Bureau of Mines pilot plant, *Mycalex Corporation,* Clifton, N. J., has succeeded in producing relatively small sheets, or large flakes, of a grade of fluorine composition mica that has a higher average level of heat resistance and electrical resistivity than the best natural mica.

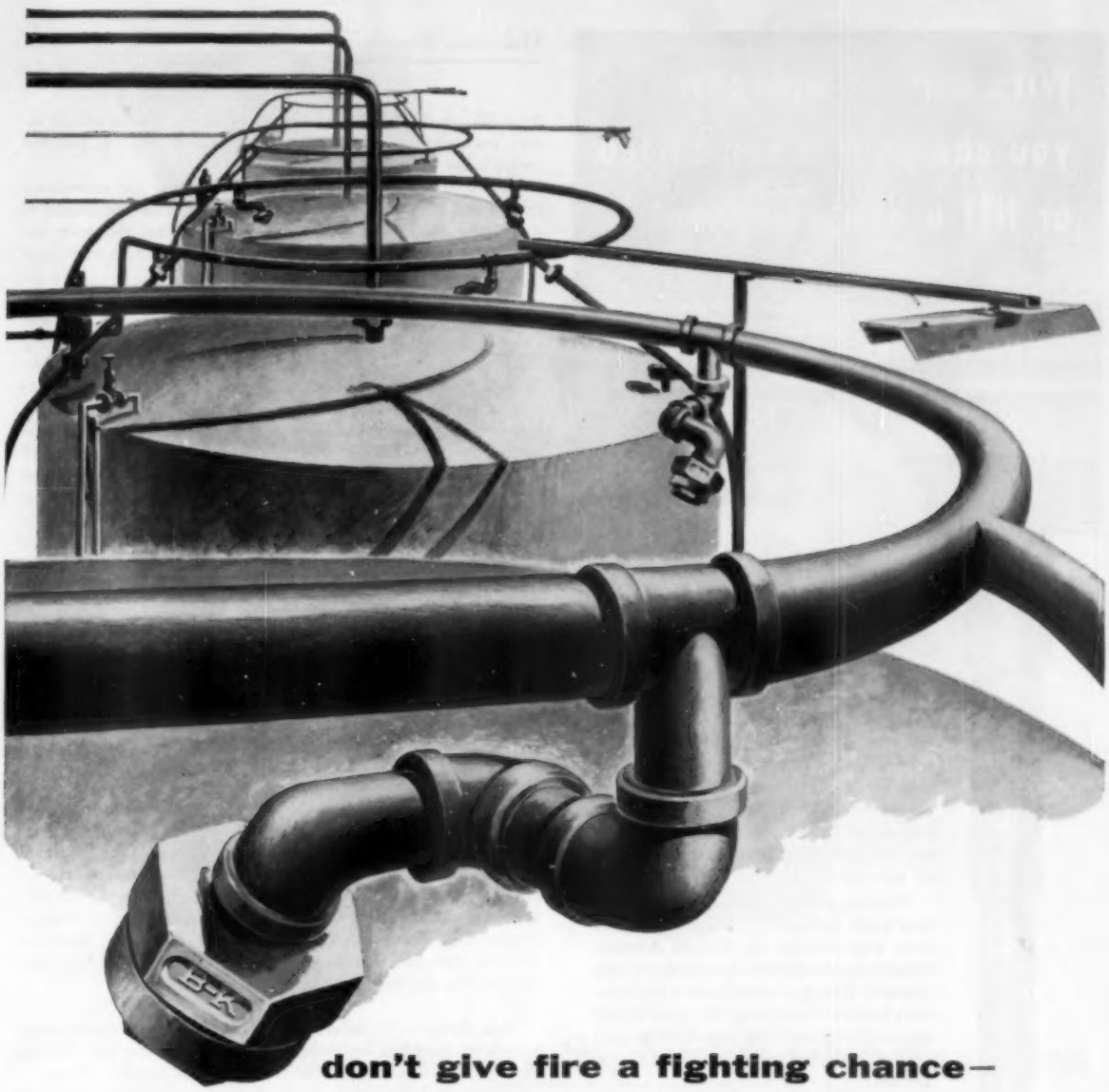
Now in pilot-plant stage at *Sylvania Electric Products, Inc.,* Mineola, N. Y., is a process for conversion of this high-grade flake mica into thin sheets suitable for insulation of such components as electronic tubes. Details have not yet been announced, but Sylvania technicians believe that even if large sheets of mica can be produced by direct synthesis it would not solve the costly labor problem of splitting, grading, and eliminating waves and imperfections.

The ideal sought for, therefore, was to set up a process by which the high-purity synthetic flake could be matted like paper and then self-bonded by crystal growth between the flakes under heat and pressure, thus eliminating the present costly hand labor and assuring sheets of absolute uniformity both in thickness and in electrical characteristics.

Several companies have been producing sheeted mica by bonding with a synthetic resin, a silicone, or a mineral bond, but in such cases the electrical resistance of the sheet is limited by the bond and, while these bonded sheets can replace natural mica for many electrical applications, they do not replace high-grade natural film for electronics.

The present method at Sylvania is to compress the felted sheets in a carbon pile through which the heating current is passed. Possible pressures are limited by the compressive stress capable of being carried by the graphite, and for the present it may not be possible to produce sheets flexible enough for capacitor grades of mica, but with the problem of all other grades well on its way to solution, our great dependence on imports of mica from India appears to be nearing an end.

New Transistor.—Designed to give maximum economy of use of the scarce strategic metals—nickel, cobalt, indium, and germanium—is a new audio-circuit transistor built to watchmaking precision by the *Radio Receptor Company,* New York, N. Y. The hermetically sealed nickel-silver case measures only 0.325-



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With this manipulator you can pour a cup of tea or lift a baby elephant

This general-purpose manipulator is designed for handling "hot" items within a protective enclosure. Eight motions are provided, with fingers that open and close and twist about their axis, a bending elbow, a twisting shoulder and a no-shake telescoping column. The hook has a capacity of one ton.

This ingenius mechanism, which was built in Farrel's Buffalo plant, is now installed in the Knolls Atomic Power Laboratories operated for the Atomic Energy Commission by General Electric Company. It typifies the unusual engineering capabilities and skilled workmanship available at Farrel.

In addition to such "specialties" as this, the company manufactures a widely diversified line of rolls, gears and heavy machinery. Write for further information.

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ANSONIA, CONNECTICUT
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Materials Progress

by 0.328- by 0.344-inch, and the three Kovar (nickel-cobalt alloy) lead wires pass through a glass header which is included within these dimensions.

Within the tiny case, nickel lead strips from the germanium crystal and from the indium emitter and collector are welded to the Kovar lead wires. As the Kovar alloy has the same coefficient of expansion as the glass header seal, there is no danger of leakage or shattering.

Frozen Mercury Casting.—Better surfaces can be obtained, and closer tolerances can be held in high-alloy parts made by the frozen mercury casting process of the *Mercast Corporation,* New York, N. Y., than are possible with the conventional lost-wax process of investment casting.

A steel matched die is used, with a central match plate containing the cores. The mercury is poured into the two sides of the die, and then the die is immersed in a bath of dry ice and acetone at minus 100 degrees Fahrenheit. When the assembly is taken from the bath, the match plate is removed, and the die halves are booked together with light pressure so that the two halves of the frozen mercury pattern adhere firmly to make a single part. Frozen mercury has the peculiar property of uniting on contact.

The solid mercury pattern is then dipped into a series of ceramic slurries which harden into a ceramic shell. When the mercury returns to normal room temperature it is poured from the shell, and the ceramic shell is baked to give it hardness and refractoriness ready for use as a casting mold. Besides high-alloy and stainless steels, titanium metal can be cast in these light ceramic molds.

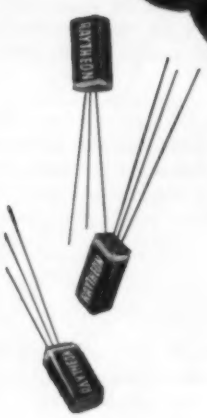
For Hot Circuits.—A multicontact plug and socket designed by *Bendix Aviation Corporation,* Sidney, N. Y., to carry circuits through aircraft fire walls, is being suggested for industrial applications in high-temperature areas. The inserts are of Mycalex molded glass-bonded mica and are cushioned with silicone wafers. The housing shells are of stainless steel. The assembly will deliver uninterrupted power during at least five minutes' exposure to a direct 2,000-degree-Fahrenheit flame and is a positive fire barrier.

New Fabric.—Nonwoven fabrics, a fairly new development, have been used for wrapping delicate instruments, for filtering, and as lint-free polishing cloths. Now, the *Minnesota Mining & Manufacturing Company,* St. Paul, Minn., has a new nonwoven material of filmy, featherweight thickness called Mistlon which is made of tightly compressed synthetic fibers and has some of the characteristics of both cloth and paper.

It can be printed on and cut with scissors like paper, and it can be washed and ironed like cloth. An additional property is that it can be heat-sealed to itself or to other materials. The material comes in rolls in widths up to 54 inches in any of 22 colors. It is suggested as an inner lining for packages, as a drapery material, and possibly for use in special insulating applications.

Metalized Plastics.—At the recent Toy Show it was revealed that fully 40 per cent of the $900,000,000 worth of toys now sold annually are made in plastics, replacing some wood but mostly metals. Many of the toys are metalized, and *National Research Corporation,* Cambridge, Mass., has developed equipment for the continuous metalizing of plastic parts by vacuum deposition, making mass production at low cost possible.

Plastics in Refrigerators.—Some models of 1954-model household refrigerators have as much as 30 pounds of plastics, replacing about 150 pounds of metals. This was a design change accelerated by the Korean war shortage of metals but not now



Transistors by the bushel from Raytheon

It's true. Raytheon, first to mass-produce junction transistors, has already made over *one million* of these Tom Thumb units – more than all other companies combined!

This leadership in designing and producing transistors, as well as semiconductor diodes, special purpose tubes, "Reliable" miniature and "Reliable" subminiature tubes, nucleonic tubes, receiving tubes, cathode ray tubes, klystrons and magnetrons, is the big reason why so many important new developments *depend* on Raytheon.

RAYTHEON

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AETNA-STANDARD
has manufacturing facilities and an engineering unit specifically assigned to Ordnance work. In connection with the Skysweeper, Aetna designed and built the pilot models for the On-Carriage Fire Control. We are now building these carriages; assembling the Fire Control; and, testing by actually tracking planes. U. S. Ordnance and Aetna-Standard have worked hand in hand for many years.
DESIGNER AND MANUFACTURER OF ORDNANCE EQUIPMENT
The Aetna-Standard Engineering Company
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considered as a substitution because the plastics are used for their engineering qualities. Frames and breaker strips are molded of styrene in one piece, and freezer compartment doors, meat compartments, control knobs, butter keeper, door shelves, and vegetable crispers, are also of molded styrene.

Freezer compartment liners, formerly of stainless steel, are of polyester-glass laminate, and ice-cube trays are of polyethylene. Nylon has been used for door-latch rollers and for the bearings for roll-out shelves. Incidentally, *Du Pont* has given the name Zytel to its molded nylon for gears and mechanical parts.

Plastic Trailers.—A new plastic family trailer of the *Hille Engineering Corporation*, Anaheim, Calif., is only four feet high in traveling position, with sleek top and sides so that the rear view of the car driver is not obscured. Fully equipped with stove, refrigerator, bunks, and accessories, the trailer weighs only 1,100 pounds, and is 12 feet long and 7 feet wide. The plastic is a polyester laminate, with a strength-weight factor higher than that of steel. For camping, a hand crank permits raising of the rounded plastic roof to a height of 6 feet 3 inches, and the sides are then closed with drop curtains.

Glass-fiber-reënforced polyester resin is also used in the all-plastic truck trailer bodies being built by the *Strick Company*, Philadelphia, Pa. They are lighter in weight than aluminum bodies of equal strength and, because they are impervious to chemical action and to odors, they are especially suited for transporting chemicals, meats, foods, and such cargoes as raw hides. The bodies never need painting, and dents or other accident injuries are easy to repair.

New Laminating Material.—A new material for making glass-plastic laminates of higher strength than is possible with woven cloth or glass mat is Glastrand of the *Strandcote Corporation*, Hawthorne, Calif. It consists of loose untwisted rovings of continuous glass fiber woven into a loose fabric. The standard material is in weights of 13 to 52 ounces per square yard, for 0.019- to 0.085-inch thicknesses. It gives better penetration of impregnating resins as well as equal strength in both directions.

Shot Shell Wadding.—New shot shells being produced by the *Remington Arms Company*, Bridgeport, Conn., have the wadding made of polyethylene plastic between two layers of resilient fiber. The tough plastic gives a more perfect seal and reduces scattering of the shot pellets, and its resiliency reduces recoil of the gun. With the same thinking, the Navy is well along on experiments aimed at replacing copper projectile bands with nylon plastic bands.

Noiseless Hinge.—A new door hinge designed by *H. S. Getty & Company*, Philadelphia, Pa., has two leaves of extruded aluminum alloy, and has combination radial and thrust flange bearings of nylon. The hinge operates noiselessly, and requires no lubrication.

Teflon Yarn.—For the first time Teflon (tetrafluoro ethylene) is being produced as a yarn capable of being woven. The 400-denier yarn with 60 filaments is being sold by *E. I. du Pont de Nemours & Company*, Wilmington, Del., only on the basis of commercial evaluation, and the possible markets are being studied.

As a textile it has unusual qualities. It has a waxy, slippery feel, and few materials will stick to it. The tensile strength is 42,700 pounds per square inch, with elongation of 21 per cent, and soaking in water does not decrease its strength. It is non-wettable. It is also nonflammable and will hold its strength to 590 degrees Fahrenheit, although the recommended use temperature is limited to 525 degrees.

It has high dielectric strength and the lowest coefficient of

Cavalcade of American Hunters

Through the years, the name "Frémont" has fired the imagination of America. Young and old can recount his exploits: "The Pathfinder," bold explorer who blazed the way to the West. Like many another famous man, John Frémont found the pleasure and excitement of the outdoor life . . . heard and heeded hunting's call.

Whether cornering bear or chasing buffalo, Frémont could always be found in the thick of the action, shouting encouragement . . . roaring triumph . . . or grumbling disappointment. That he experienced all the thrills of hunting is evidenced by his diaries. His account of a typical buffalo hunt all but puts the gun in the reader's hands: "Rising in the stirrups, I fired at the distance of a yard . . . She fell headlong at the report of the gun." A strong and vigorous man, Frémont took pride in meeting—and besting—hunting's challenge.

History has shown that hunting is more than a popular sport. Since pre-Revolutionary days, it has provided healthy, exciting action for thousands who follow the lure of the open. Equally important, hunting has served to build self-reliance and endurance—helping to keep our nation strong.

Today, the great American tradition of hunting can be perpetuated only through thoughtful preservation of wild life. Throughout the country, hunting associations are cooperating with public agencies to promote proper conservation and management of our game resources. Do your part in preserving the heritage of hunting. Join one of these public-spirited groups now. E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., Wilmington 98, Delaware.

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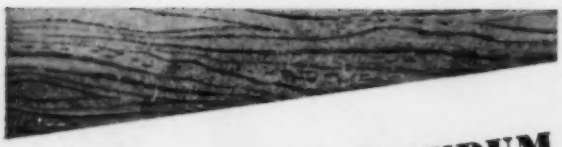

MEMORANDUM

To: Ordnance Engineering Officers

From: Gear Specialists

Subject: Solution to Gearing Problems

For more than 50 years our engineer-specialists have successfully met and solved problems in the design and application of high precision gears.

This invaluable experience is available to you, either on a consultation basis when you need an 'engineering assist' – or, in the form of Fellows equipment best suited to your needs of cutting, finishing and testing gears for all branches of the service.

If currently faced with a gearing problem, a call or letter will bring a Representative. No obligation, of course.

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friction of any fiber. It cannot be dyed easily, and the colors are limited to tan to brown, but it can be bleached white. It is not attacked by common solvents and chemicals. Suggested uses include filtration fabrics for liquids and gases, conveyor belts for foodstuffs and sticky materials, insulating fabrics, and gaskets and packings.

Refractory Metals.—Molybdenum disilicide is a new refractory hard metal that is highly resistant to oxidation at high temperatures, is not attacked by mineral acids, and has a Knoop hardness of 1240, which is about the same as that of tungsten carbide. *American Electro Metal Corporation,* Yonkers, N. Y., has made parts from the material by powder metallurgy by direct combination of molybdenum and silicon powders. The material has the chemical composition $MoSi_2$ and forms a tetragonal crystalline structure. The melting point is about 3,400 degrees Fahrenheit.

Specializing in research and production of the new refractory hard metals is the *Borolite Corporation,* Perth Amboy, N. J. These materials, originally called Hartstoffe in Germany, should not be confused with the hard carbide tool materials nor with the hard cermet coating materials. They are true chemical compounds of two or more metals and come in single large crystals or are made into parts by bonding the crystalline powder to itself by recrystallization under heat and pressure.

Chromium boride, one of Borolite's refractory hard metals, is an extremely hard powder in several crystal phases. Chromium boride parts produced by powder metallurgy have a specific gravity of 6.20 to 7.31, with a Rockwell A hardness of 77 to 88. The parts have good resistance to oxidation at high temperatures, are stable to strong acids, and have high heat-shock resistance to 2,400 degrees Fahrenheit. The transverse rupture strength of the parts is from 80,000 to 135,000 pounds per square inch. The material can be used for parts requiring strength at extremely high temperatures and high hardness.

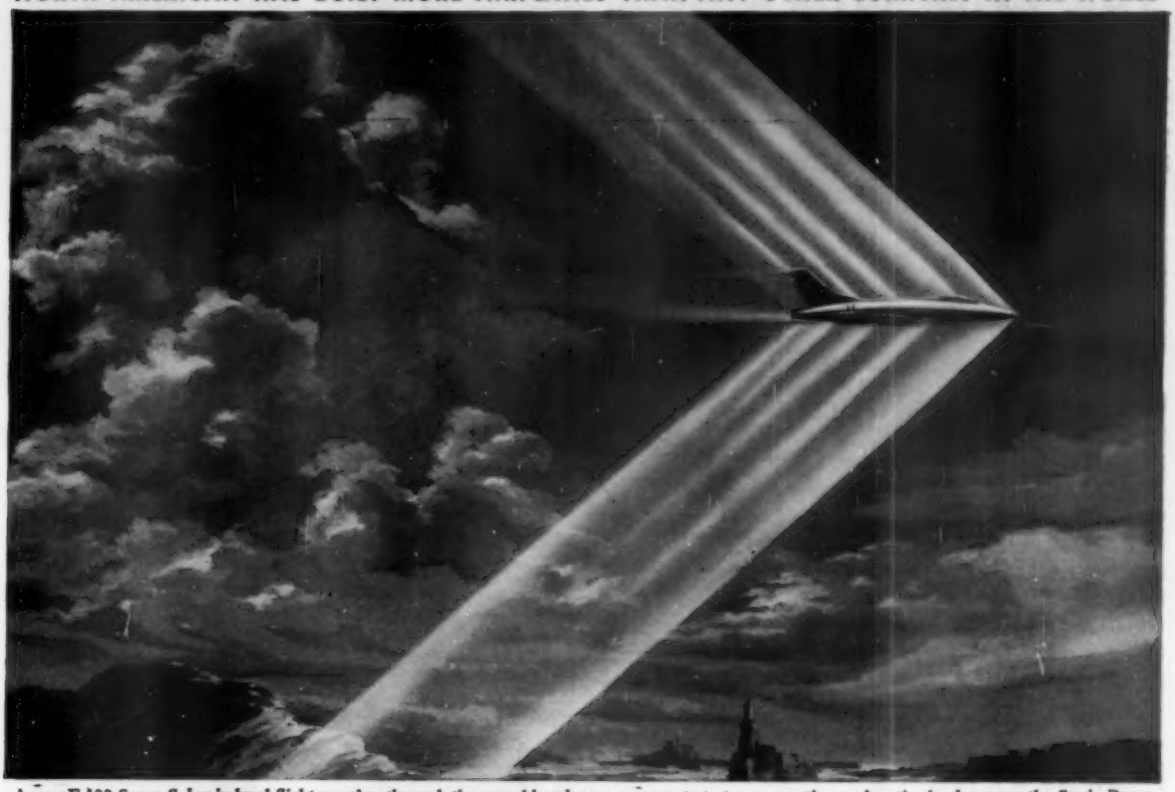
Tempering Tools.—For furnace tempering of tools, dies, and steel parts, the *Reynolds Metals Company,* Louisville, Ky., suggests wrapping the tools in aluminum foil. The foil enclosure prevents discoloration of the tool in the furnace and retains the original bright polish. The method can be used only for heat-treatment temperatures below the melting point of aluminum.

Silicone Binders.—The *Naval Ordnance Laboratory,* White Oak, Md., has developed a series of silicone binders for plastic-glass laminates that will give strong chemical bonds between the glass and the plastic, as plastics do not normally adhere well to glass. The materials are reaction products of allyl trichloro silane with phenol, resorcinol, meta cresol, and xylinol, depending on the plastic resin which is to be used.

Titanium Alloy.—While titanium metal still remains too costly for large-scale use in civilian products, much knowledge of its properties and working characteristics is being gained from the increasing military applications, and continued research on new alloys is going forward. Latest alloy to be offered on the market is Rem-Cru alloy C130AM, of *Rem-Cru Titanium, Inc.,* Pittsburgh, Pa., an alloy that is twice as strong as straight titanium metal and can be forged more easily than previous titanium alloys.

The alloy contains four per cent aluminum and four per cent manganese, with the balance titanium. The aluminum is a stabilizer for the alpha form of titanium, which is the hexagonal crystal structure assumed by the metal at temperatures below 1,625 degrees Fahrenheit. The manganese tends to stabilize the beta form of titanium, which is the cubical crystal structure taken by the metal at high temperatures.

NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD



A new F-100 *Super Sabre* in level flight smashes through the sound barrier over a remote test area creating a gigantic shock wave—the Sonic Boom.

SONIC BOOM!

THUNDERING SIGNAL OF AVIATION'S PROGRESS FOR NATIONAL DEFENSE

Called "mysterious thunder" when first heard, Sonic Booms have demonstrated to Mr. Average Citizen the fact that we have entered the era of everyday supersonic flight. The mere idea that an airplane flying through the air can produce a sound "like thunder on a clear day" may seem fantastic. Actually a Sonic Boom is a perfectly natural occurrence . . . a sort of gargantuan "pop"... brought about by a jet plane flying faster than sound. Very much like waves made by a motorboat on a lake . . . a jet creates gigantic shock waves in the air . . . so immense, that when they reach us on the ground, they sound like thunder or a rumbling explosion.

Once a surprising new sound . . . the cause of Sonic Booms is now understood, and positive steps minimize the probability of Booms over our homes. For instance, North American began early testing at supersonic speeds over remote areas. These experiments have led to rigid control of all flights. Today, the aircraft industry and the Armed Forces prevent disturbing Booms by making supersonic flights at extreme altitude or away from our cities and towns.

While you read these words, planes designed and built by North American . . . like the F-86 *Sabre* Jet and the new F-100 *Super Sabre*—America's first operational fighter to fly at supersonic speeds in level or climbing flight—fly vital defense missions without disturbing your daily life.

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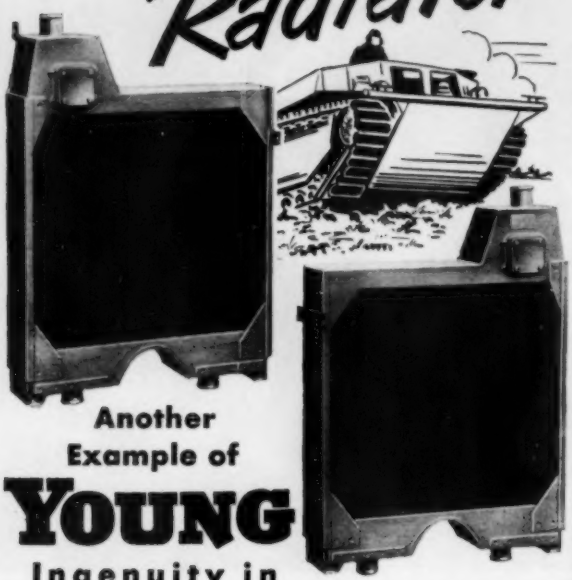
THE TRUE STORY OF A "Two-Faced" Radiator



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Heating, Cooling, Air Conditioning Products for Home and Industry

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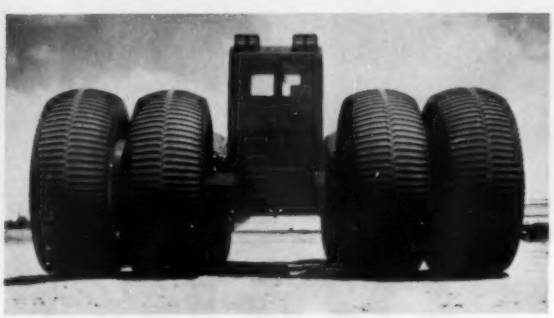
NEW DEVELOPMENTS

GIGANTIC EXPLORER

A gigantic exploratory vehicle and prime mover, known as the Sno-Buggy, has been developed by R. G. LeTourneau, Inc., Longview, Tex. Eight huge tires, made by Firestone Tire & Rubber Company—each ten feet high and four feet wide—are mounted in dual fashion on the four electric wheels, providing a high degree of support and flotation for the 23-ton vehicle. Possibilities for the Sno-Buggy's use over unstable terrain are believed to be almost limitless.

Each wheel has its own built-in electric drive motor and gearing system, simplifying the design of equipment with all-wheel drive and all-wheel steer. A 400-horsepower engine and generator provide power for the motors.

The operator is in a cab at the front of the machine. He easily controls the vehicle's travel, including steering, by small electric switches. The braking method is a regenerative electric system.



The LeTourneau Sno-Buggy has eight 10-foot tires.

For emergency stops and parking there are spring-loaded, bimetallic friction brakes integral with the wheel motors. They set automatically when the electric power to the motors is turned off. The speed of the machine over deep snow, boggy swampland, or loose sand is eight miles an hour, forward or backward.

NEW BRITISH SUBMACHINE GUN

A new British submachine gun which has been tried out in active service conditions in the Far East and in Kenya is to be issued throughout the British Army. It will replace the Sten machine carbine, according to the British publication, *Soldier*.

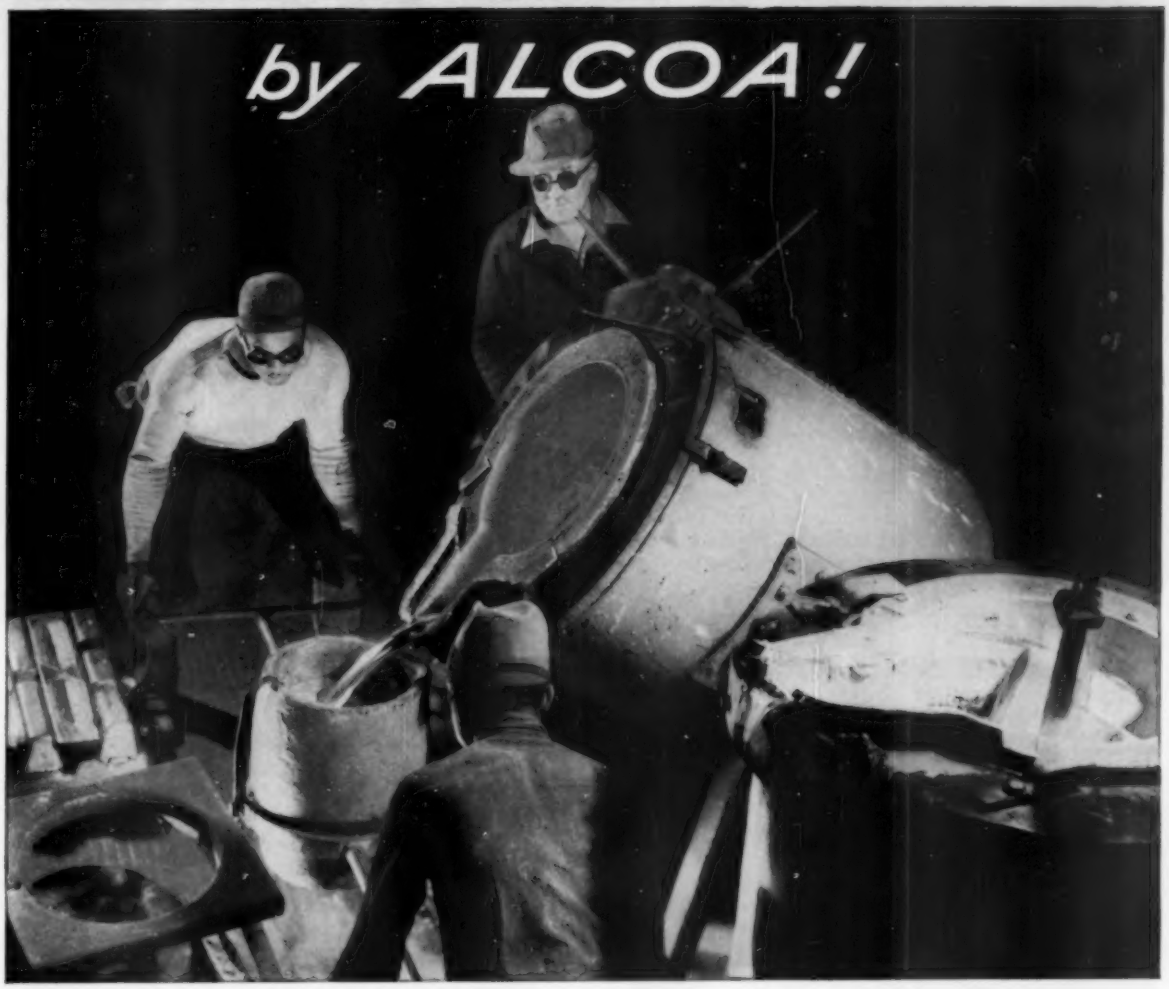
Early models of the weapon received some publicity as "the Patchett gun." Since its first appearance the gun has been developed and is now known officially as the L2A1.

The new gun weighs only six pounds (more than two pounds lighter than the Sten) and is two inches shorter, even when the folding stock is fully extended. With the stock folded the L2A1 is only eighteen inches long and can be used like a machine pistol in confined spaces like the corridor of a house or thick jungle. With the stock extended and bayonet fixed it can be used almost as effectively as the rifle for bayonet fighting.

Its accuracy is greater than that of the Sten. An expert shot a 4- by 6-inch group at 100 yards and a 12- by 8-inch group at 200 yards while a squad of soldiers nearly all obtained a 12- by 12-inch group at 100 yards. This is far better than the Sten could do except in the hands of experienced shots.

There are several reasons for this improved accuracy. The pistol grip is built well underneath the gun at about the point of balance so that there is no pull down from the nozzle as there was with the Sten. The bolt action is smoother and there is no

CASTINGS



Over one-fourth of all the aluminum produced winds up in cast form. In an effort to fulfill the tremendous demand for products made from this process, Alcoa operates five modern casting plants. In Vernon, California, and Bridgeport, Connecticut, and Cleveland, Detroit and Buffalo, Alcoa makes castings of every type—sand, die, permanent mold and plaster—both in aluminum and in magnesium.

If casting rejection is a problem in your plant, then you should know of Alcoa's recent advances in casting processes. We make sand castings with walls ⅛″ thin, and we hold tolerances to 1/32″. The permanent-mold process, once limited to small parts, now includes 800-lb bearings and 250-lb pistons. Our plaster castings now compete price-wise with die castings and are held to within ±0.005″. Our plants are producing die castings as strong as, and in finished form, less expensive than, equivalent parts in cast iron.

Chances are you haven't taken the time lately to find out exactly what your castings cost you. We don't mean the foundry price—we mean the price as finished and assembled. As a part of the Alcoa team which has helped many other companies slash the number of casting rejects, we offer this suggestion. Scrapped casting costs are worth a look-see in your plant, and the man to help you do this is your Alcoa sales engineer. ALUMINUM COMPANY OF AMERICA, 850-J Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

violent "chatter." In addition the L2A1 is fitted with a curved magazine which incorporates roller bearings to ease the entry of each round into the breech. The magazine holds thirty-four rounds against the Sten's twenty-eight, but a Sten magazine can be used in an emergency.

The L2A1, which like the Sten has a caliber of 9 mm., can fire single shots or bursts. Bullets leave the gun at the rate of 540 a minute and the effective range is 200 yards. The Sten's change-lever stud has been replaced in the new gun by a safety catch which is pushed forward from safe to single rounds and forward again for automatic fire. Other innovations are a swivel aperture back sight and a locking apparatus which holds the breechblock in either the forward or rear positions so that it is always safe until the safety catch is pushed forward.

NEW DIRECTION FINDER

A new portable radio which serves also as a marine direction finder to help boatsmen determine their positions at sea was announced recently by Raytheon Manufacturing Company. It receives the regular AM broadcast band and also marine and beacon bands. The direction-finding antenna is flat and projects only two inches above the case. The whole radio weighs only thirteen pounds, including batteries, and measures twelve inches wide by seven inches deep and high.

The boat owner may listen to his favorite radio program and at the same time rotate the antenna until it points directly at the radio station. In this way the mariner may obtain a "fix" showing his exact position at sea, using ordinary commercial radio stations. The 1,700-3,400-kilocycle "marine" frequencies are useful in locating vessels operating radiotelephones and in obtaining weather information. The set also receives the 200-415-kilocycle "beacon" band, enabling the boat owner not only to make extremely accurate fixes, but also to locate lightships and danger points marked by Government beacons.

Portable radio and direction finder.

SLOWER LANDINGS

A "significant aëronautical development" by a Navy Bureau of Aëronautics engineer will give future carrier-based planes the ability to land slower and carry thousands of pounds more armament than is now possible. Very simply, air is bled from the jet engine and blown out over the trailing edge of the wing. Through holes in the duct the air blows out at high speed and tends to make the normal flow of air hug the wing skin rather than "burble" when the plane is at slow or near-stalling speeds.

By making the flow of air over the wing at slow speeds steady, the lifting capacity of the wing is greatly increased, thus lowering the safe landing speed. During take-off, the same system will measurably increase the load-carrying capacity of the plane.

AUTOMATIC TURRET

A remotely controlled tail turret system, capable of knocking down enemy interceptors in the night or in fog, has been developed for the B-47E Stratojet. The new system is especially adapted for high-speed jet operation and consists essentially of a tail turret mounting twin 20-mm. cannon, a computer, control equipment, and search-track radar.

In danger areas the radar is switched to "search" to maintain a watch to the rear. When an attacking plane is picked up, a "pip" shows on the radar screen, and once the target is centered in the cross hairs, it is tracked automatically. The tracking action supplies the computer with the necessary information, and when the attacking plane gets within range, the guns are fired.

RADIATION MONITOR

The National Bureau of Standards has developed a remote-control system which automatically measures radiation intensities and other variables in the vicinity of an atomic explosion and transmits the data by radio to a centrally located headquarters. The system was designed at the request of the Division of Biology and Medicine of the Atomic Energy Commission for use in nuclear tests.

Though developed specifically for monitoring gamma radiation and weather conditions, it can be used with a wide variety of detectors to report many types of information. Except for the control station, the entire system is battery-powered and

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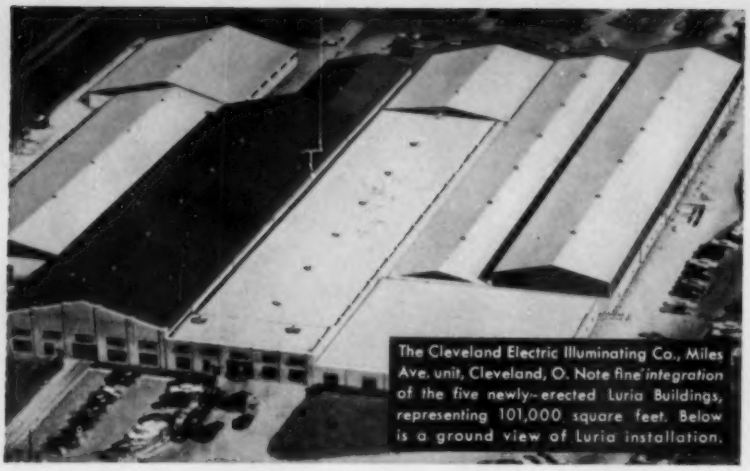


The Cleveland Electric Illuminating Co., Miles Ave. unit, Cleveland, O. Note fine integration of the five newly-erected Luria Buildings, representing 101,000 square feet. Below is a ground view of Luria installation.

Another Industrial Leader
chooses

LURIA Standardized Buildings

GENERAL CONTRACTOR H. W. HARCUSON BUILDERS, INC.

LURIA puts the permanence and flexibility of CUSTOM-BUILT STRUCTURES into your expansion program ...without sacrificing the advantages of STANDARDIZATION

Standardization provides the high speed, low cost answer to today's building problems, of course. But *Luria* standardization brings you something more...gives you *complete freedom* of design and architectural treatment, as well. There is practically no limit to the way Luria standardized units can be *integrated* with your present structures . . . or "custom-designed" for your new projects! And every Luria installation is *engineered* to meet the most exacting building code requirements. To know more about these and the many other advantages of Luria Standardized Buildings, contact your Luria representative today. *It pays.*

LURIA ENGINEERING Company

500 FIFTH AVENUE, NEW YORK 36, N. Y.

District Offices: ATLANTA • PHILADELPHIA • BOSTON • CHICAGO • WASHINGTON, D. C.

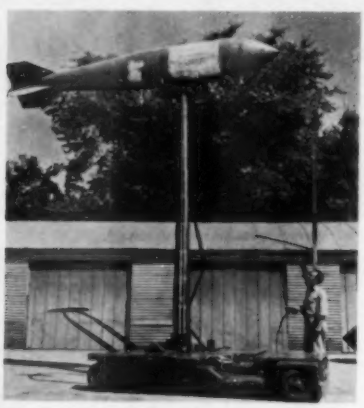
New Developments

will operate unattended for long periods.

The system permits the operator at the control station to select one of several data stations for transmission of data and to determine what particular type of information is to be reported. The radio link and the station interrogation system were designed and constructed by the Motorola Corporation and are based largely on their quarter-watt portable transmitter-receiver and other standard equipment.

NEW BOMB LIFT

Rapid and positive loading of the huge bombs carried by modern military aircraft poses a real materials-handling problem. Space and weight limitations in the plane itself make the installation of handling equipment in the bomb bay impractical. Weight of the bombs is such that manual handling is difficult and dangerous.

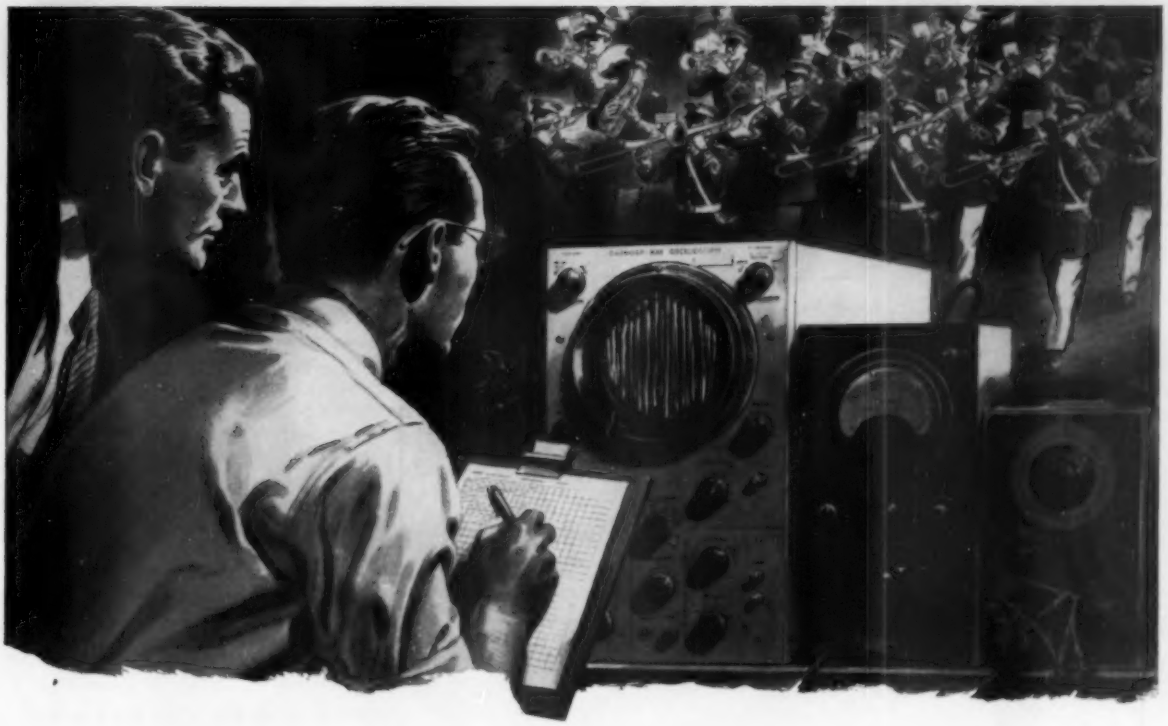


New bomb lift elevates 15 feet.

To overcome these handling obstacles, Standard Manufacturing Company, Dallas, Tex., has designed and built a compact bomb lift for the Air Force that handles bombs weighing up to 4,000 pounds. Completely self-contained, the unit is motorized to travel from pickup point to the aircraft waiting line under its own power. Low-slung design keeps the unit stable under heavy loads and facilitates the servicing of squatty jets as well as higher-standing aircraft.

BALL POWDER PLANT

The final phase of construction is now under way and production is expected to start in November at the Army Ordnance Corps' new $21 million ball-powder plant at Badger Ordnance Works. Located near Baraboo, Wis., Badger is a Government-owned Ordnance installation which has been operated under contract since 1951



These men are judging a military band!

Doesn't look like a parade, does it? Looks more like an electrical laboratory. As a matter of fact it *is*—a lab in Stromberg-Carlson's Sound Division—but it represents one good reason why band music sounds so good when you hear it reproduced on radio or records.

That's an oscilloscope—an instrument you probably associate with radio, radar, electrical experiments and the like. Actually, these technicians' interest in the wiggling lines on that screen has direct influence on the quality of music that you hear in your living room.

You see, most modern recordings capture and impress on the surface of a disk *all* the music that an artist created. Many record players, however, reproduce as little as one-half of it. When the equipment *is* capable of re-creating the full range of sound necessary for lifelike reality, it is said to be "high fidelity."

Stromberg-Carlson's radio tuners, record turntables, amplifiers and speakers are made to reproduce every tone from the lowest boom of a bass drum to the highest trill of a piccolo. We use oscilloscopes, which show visually whether the equipment is hitting all the highs and lows it should. We use lots of other devices, including endless patience. It makes our Hi-Fi products cost more than many other brands—but it also makes true music-lovers completely happy.

It's a far cry from family music to a combat unit's intercom problems, but we're in the latter business, too. In fact, you'll find the Stromberg-Carlson label on communication and electronic equipment just about anywhere the flag flies!

There is nothing finer than a

Stromberg-Carlson® Rochester 3, New York

STROMBERG-CARLSON LEADS TOO IN:

Telephones and Central Office XY Dial Equipment

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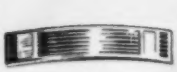
Lapel Emblem



Lapel Bar

Ribbon Lapel Rosette

Medal

Available only to Association members, the official insignia will identify you as a loyal A.O.A. supporter, and a patriotic American. You'll want to wear the emblem, rosette, or bar on fitting occasions, and display the plaque and membership certificate in your home or office. Insignia are in the attractive ordnance colors—maroon and gold.

Indicate your preference below and return this form with your check to Association headquarters. Postage is prepaid to domestic destinations.

	Quantity Desired	*Amount*
Lapel Emblem (bronze), $1.50	. . . . .	. . . . .
Lapel Bar (bronze), $1.00	. . . . .	. . . . .
Ribbon Lapel Rosette, $1.00	. . . . .	. . . . .
The Medal (bronze), $2.50	. . . . .	. . . . .
Wall Plaque (8″x9″), $3.00	. . . . .	. . . . .
Bar Ribbon, 50¢	. . . . .	. . . . .
Ribbon (1½″), $2.00 a yard	. . . . .	. . . . .
Lapel Ribbon (¼″), $1.50 a yard ($0¢ ¼-yard)	. . . . .	. . . . .
Membership Certificate, $1.50	. . . . .	. . . . .
Cigarette Lighter, $5.00	. . . . .	. . . . .
Tie Chain, $5.00	. . . . .	. . . . .

Federal Tax included in prices

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Please send me insignia as indicated above. My check for $..... is enclosed. Mail to:

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New Developments

by Liberty Powder Defense Corporation, a subsidiary of Olin Industries, Inc. Up to now, Badger's two products have been propellent powders for artillery shells and rockets. Ball powder is a propellent powder for small-arms ammunition used in pistols, rifles, carbines, and machine guns up to caliber .50 and 20 mm.

MAGNETIC RECORDER

The Navy Bureau of Ships recently completed development of a new magnetic tape recorder designed to operate reliably aboard naval vessels under such conditions as shock, gunfire, severe vibration, extremes of temperature and humidity, and rolling and pitching of the vessel. It also is being evaluated for suitability for service uses ashore. The recorder is equipped to utilize 1,200-foot reels of standard ¼-inch magnetic recording tape. Twin channels are employed and arranged so that two recordings can be made simultaneously, or one recording can be made while a previously made recording is being played.

NEW BALANCING DEVICE

Extremely high standards of accuracy and sensitivity in the static balancing of rotating parts such as cooling fans, helicopter rotors, etc., have been established

Meter indicates unbalance in cooling fan.

by Dean & Benson Research, Inc. This achievement is the result of the newly developed vertical balancing rod on which Baldwin SR-4 resistance wire strain gages are bonded. This rod supports rotors to be balanced. Unbalance and its location are detected by bending strains in the rod. The measuring instrument for the balancer was developed by RugedeForest Inc., affiliate of Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa.

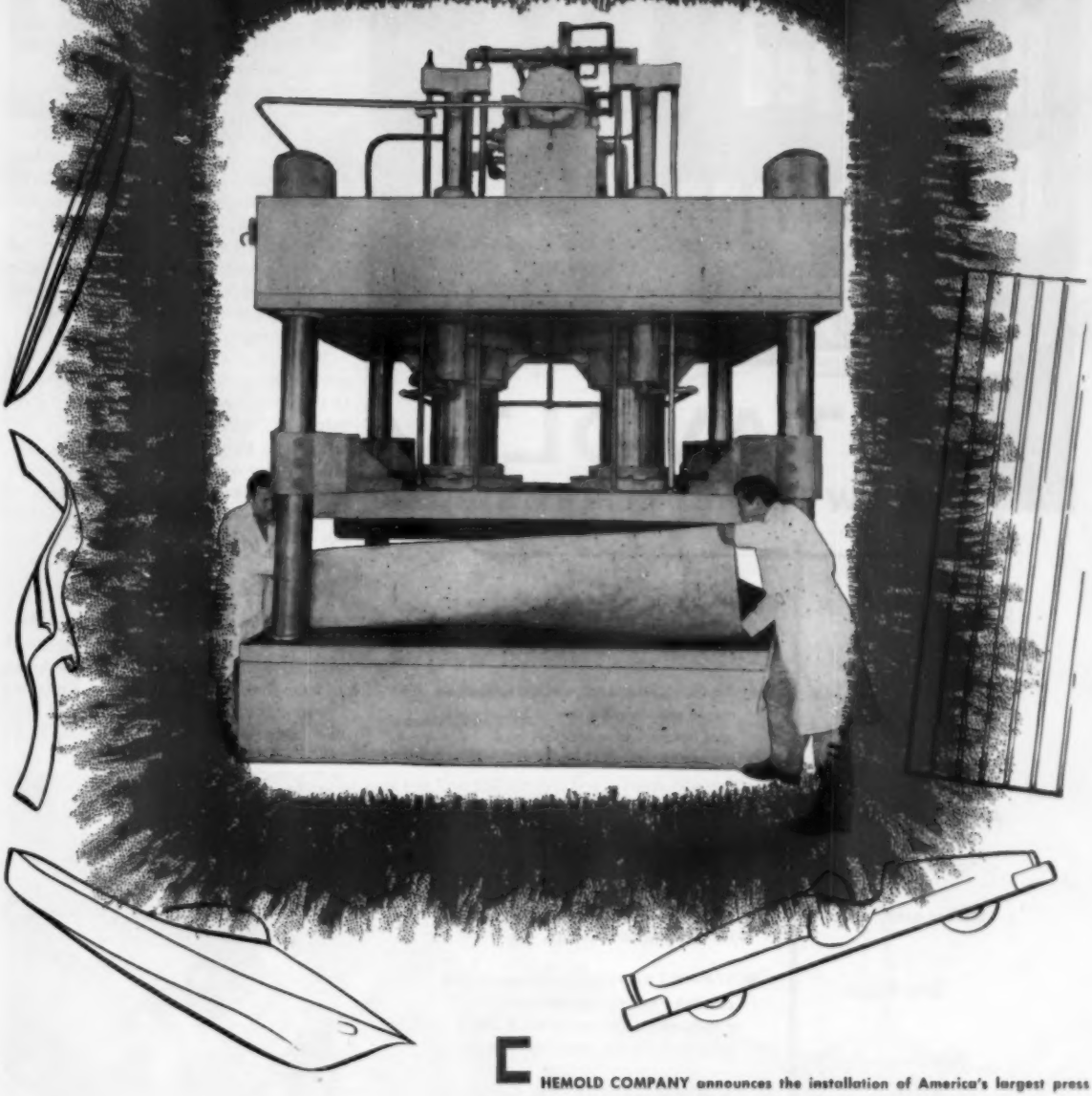
ROCKET-PROPELLED SLED

The Air Force set a new speed record on the ground recently when Lieut. Col. John P. Stapp, riding in a rocket-pro-

NOW for BIG jobs

REQUIRING MATCHED-METAL MOLDS

IT PAYS TO COME TO CHEMOLD



CHEMOLD COMPANY announces the installation of America's largest press for matched-metal mold operation. This double-ram action press develops 750 ton pressures and is presently being scheduled to turn out precision production of fiberglass parts up to 5' in width and 14' in length. Write for availability for your product.

IT PAYS TO REMEMBER . . . for reinforced plastic by matched-metal mold—it can be done faster and better by Chemold.

CHEMOLD COMPANY Manufacturers of Glass-Fiber Reinforced Plastic Products

2000 COLORADO AVENUE, DEPT. OM-9, SANTA MONICA, CALIF.

A NEW TYPE RECTIFIER

For Closely Regulated D-C Voltage

C&C

STAVOLT®

POWER RECTIFIERS

Closely Regulated by Magnetic Amplifier Control of unique and stable qualities.

Low Ripple

Fast Response

- Ten standard 28 Volt production models up to 1000 amperes, many others, mobile or stationary.
- Amazing size and weight reduction made possible by use of latest core and insulation materials and aluminum construction.
- Encapsulated components—shock mounted meters recessed behind plastic windows.
- No tubes—lamps—carbon piles—commutators or moving contacts and no radio interference.
- STAVOLT Rectifiers are rugged and can take heavy intermittent overloads. They meet MIL-E-7894 with both range and characteristics.

Engineers will be interested in learning more about the fine qualities of STAVOLT Rectifiers. Write for catalog with detail specifications.

McCOLPIN-CHRISTIE CORP.

3400 West 67th Street, Los Angeles 43, Calif.

25th Year of Rectifier Manufacturing

pelled sled at Holloman Air Force Base, Alamogordo, N. Mex., attained a speed of 421 miles an hour. The ride was the initial human sled run of a series in which Colonel Stapp, chief of the Aëro Medical Field Laboratory at Holloman Air Development Center, hopes to determine the effect upon fliers of bailing out at very high altitudes and at supersonic speeds.

The test sled is an especially constructed vehicle designed by Northrop Aircraft, Inc., Hawthorne, Calif., according to specifications established by scientists of the Air Research and Development Command. It is expected eventually to carry volunteers at speeds up to 800 miles an hour. At the 4,902-foot altitude at Alamogordo a speed of 800 miles an hour is equivalent to 1,800 miles an hour at 40,000 feet—the difference being caused by the variation in air density at the different altitudes.

The actual speed attained is not the critical factor in the sled runs; rather it is the abruptness of the stop and the resulting "G" force upon the subject. A "G" is equal to the force of gravity. The purpose of the deceleration-sled program is to develop procedures and equipment to enable crews of supersonic aircraft to bail out at high altitudes and survive.

SKY COMPASS

A sky compass, claimed to be the first practical instrument for accurate aërial navigation in high latitudes, was designed and developed recently by the Kollsman Instrument Corporation laboratories. The new compass gives the true heading of an aircraft by determining the position of the sun when it is below the horizon.

Sky compass for polar navigation.

For true heading readings the compass utilizes the polarized light from the sun, present in the sky when the sun is below the horizon. This is particularly important because, during prolonged twi-

it's a matter of

PRECISION!

The lift, the power, the drive . . . yes, the air-borne heart . . . of the YH-21 Piasecki "WORK-HORSE" Helicopter are delivered by the three transmissions shown here . . . the forward, mid and aft. For *this* kind of component fabrication, the best single manufacturing asset is the PRECISION for which *Steel Products* is famous!

"Precision in Aviation Since 1914"

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ROLOCK
FABRICATED ALLOYS

BASKET SERVICE THAT'S HARD TO BEAT

AT WILLYS MOTORS, INC. ALUMINUM FORGE DIVISION

Shown in action is one of 24 similar stainless steel etch baskets designed and fabricated by Rolock Incorporated. Dimensions are 6′ x 3′ x 16½″; load is 500 lbs. of aluminum forgings . . . thru the following 6-cycle operations:

A. Acid pickle, 10% sulphuric acid, 3% chromic acid solution at 160° F.
B. Cold water rinse.
C. Etch in 10%-15% caustic solution at 160°-180° F.
D. Cold water rinse.
E. Bright dip in 10% sulphuric acid, 3% chromic acid solution at 160° F.
F. Hot water rinse.

EACH BASKET has been subjected to an average of 125 cycles per month for more than SIX YEARS . . . and they're still going strong . . . after a total of about 10,000 cycles. THAT IS SERVICE!

This Case History is another demonstration of the value of Rolock engineered-to-the-job, fabricated-welded design and construction of containers for handling metal parts.

Extended service life reduces costs materially, improves the work, cuts time. Rolock design and construction raises the ratio of load to basket weight, thus again reducing costs.

Rolock engineers welcome your inquiries for baskets, trays, racks, crates, fixtures, retorts, muffles, vessels, kettles, etc., for heat and corrosion resistant applications.

Send your tough problems to us for solution. We welcome the challenge.

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JOB ENGINEERED for better work
Easier Operation, Lower Cost

6RL54B

New Developments

light conditions in latitudes above 70 degrees, standard navigation instruments cannot be used since they rely upon the sighting of the sun, the planets, or the stars, and the magnetic compass cannot be relied upon in these regions.

ELECTRONIC COMPUTER

DYSEAC, a high-speed digital computer designed to serve as the experimental nucleus for a complex data-processing network, has been completed by the National Bureau of Standards. The flexibility with which this machine controls and responds to a variety of external devices, which may include one or more full-scale computers of similar design, should enable scientists to explore diverse new areas of interest.

Examples include the automatization of industrial and commercial operations, such as the "automatic factory" and the "automatic office," or any field where rapid information-processing and real-time control systems are necessary.

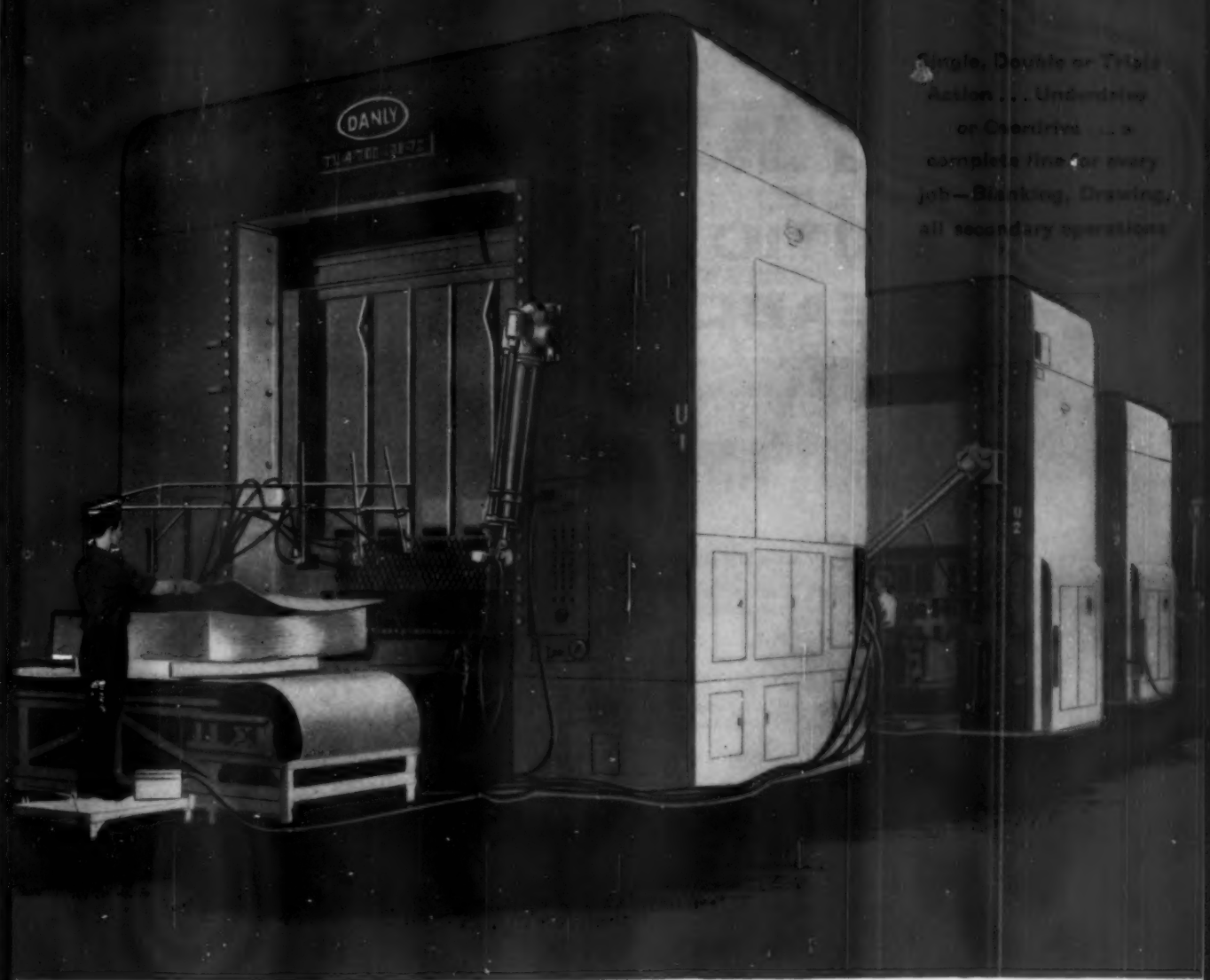
The DYSEAC development program was undertaken in 1952 by the staff of the Bureau's Electronic Computers Laboratory under the sponsorship of the Department of Defense. The objective of the program at that time was to produce a general-purpose high-speed digital computer that could serve both as a versatile tool for solving a variety of system-simulation problems and as a proving ground for evaluating certain novel logical design features and component packaging techniques. Subsequently, the sponsorship was assumed by the Signal Corps, to whom DYSEAC was delivered May 3, 1954, for a special application.

VIBRATION ANALYZER

A new portable electronic vibration analyzer, capable of balancing rotating parts at speeds up to 5,000 revolutions a minute and of tracing any vibration up to 20,000 cycles a minute, has been released by the International Research & Development Corporation of Columbus, Ohio. The device is designed to eliminate vibration in production machinery and to simplify maintenance of plant equipment

Analyzer traces harmful vibrations.

DANLY PRESSES



Single, Double or Triple Action . . . Underdrive or Coaxdrive . . . a complete line for every job—Blanking, Drawing, all secondary operations

DANLY

MECHANICAL PRESSES
50 TO 3000 TONS
SINGLE, DOUBLE, TRIPLE ACTION
AUTOFEED . . . UNDERDRIVE

Get these proven cost and production advantages on every stamping operation in your plant . . .

1. Stronger, heavier construction for dependable performance even under continuous peak load operation.
2. Extra rigidity for longer die life.
3. Exclusive electrical and pneumatic control developments for faster, safer operation.
4. Automatic oil lubrication to decrease maintenance requirements.

Make your whole line a Danly line . . . remember, for every operation, it costs less to run a Danly Press.

DANLY MACHINE SPECIALTIES, INC.

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wider and wider use

PEARLITIC MALLEABLE CASTINGS

as engineers become aware of its many advantages

DESIGN ADAPTABILITY: Because of its good fluidity, it can be cast in thin sections and in complicated shapes.

HIGHER STRENGTH: Ultimate strengths range between 60,000 and 90,000 psi; yield strength between 40,000 and 70,000 psi.

EASILY MACHINED: Machinability index (B1112 Steel = 100) ranges between 80 and 90.

WEAR RESISTANCE: Withstands excessive wear under heavy loads at high speeds.

LOCALIZED HARDENING: Sections of the casting can be flame hardened or induction hardened before or after machining.

BEARING PROPERTIES: Good non-seizing properties in metal-to-metal contact.

FINE FINISH: Can be given a very smooth finish where desired.

You will find many applications for Pearlitic Malleable castings – particularly as a replacement for forgings, stampings and weldments – where reduced weight, less machining time, fewer assembly operations and better appearance are important production and sales considerations.

A-9056

NATIONAL MALLEABLE AND STEEL CASTINGS COMPANY

Cleveland 6, Ohio

The Nation's largest independent producer of malleable and pearlitic malleable

New Developments

through dynamic balance of rotating parts.

The instrument, which weighs only 24 pounds, can be carried to a machine tool producing poor finish or rejects because of chatter and vibration. Balancing, with the aid of a stroboscopic lamp with a range up to 5,000 flashes a minute, is done through a short 4-step procedure. The part is balanced while running at design speed in its own bearings.

NEW GYRO COMPASS

U. S. military pilots soon will know, better than ever, where they are headed because of a new compass system, said to be three to four times more accurate than previous navigational systems, developed by the General Electric Company. Offering a free gyro drift rate of less than four degrees an hour, compared with the old standard drift rate of twelve to eighteen degrees, the device is expected to add materially to the success of strategic military flights.

Secret of the compass system's accuracy is a radically new gyro motor design with sufficient operating force to meet the requirements for a low drift rate yet offering simple construction, small size, and low weight.

SIMULTANEOUS INSPECTOR

A gage that inspects thirteen dimensions simultaneously on a rear planetary carrier assembly is a recent development of the Sheffield Corporation of Dayton, Ohio. It indicates by means of colored lights whether or not the thirteen dimensions are oversize, undersize, or within tolerance.

Parts can be inspected on this gage at a rate of 600 to 800 an hour at 100 per cent efficiency. Dimensions checked include two locations on four outside diameters, the inside depth at four places, and outside height of the base.

FIRE FIGHTING CHEMICAL

Chlorobromomethane—known as "CB"—is the "wonder chemical" developed by a London firm now being introduced into special fire-fighting equipment for airfields, promising new hope for saving people trapped in red-hot wreckage. This equipment is already on order for the U.S. Air Force in Europe and for the Royal Air Force.

A comparatively small quantity of CB can extinguish a dangerous fire in less than half a minute. Tests on airfields covered with gas and oil waste and littered with fire-attracting debris from aircraft interiors proved that a flaming fire in a gasoline-soaked airplane could be totally extinguished with sixty-six pounds of the chemical within twenty seconds.

Where's "Charlie"?

The "bird" will find him!

As it rockets along at supersonic speeds—high above the earth—its guidance system directs it unerringly to target "Charlie."

Electronics makes today's accurate missile guidance a reality—and *electronics* is the past, present and future of RCA.

For years, RCA has been working with the Armed Forces on design and engineering of more accurate, more effective missile-guidance systems. The same RCA engineering facilities—from original planning to final production stages—are available for development of complete electronic systems of all kinds. For additional information, write to Government Department, Engineering Products Division, Radio Corporation of America, Camden, N. J.

GOVERNMENT DEPARTMENT

RCA®

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DIVISION CAMDEN, N.J.

PRODUCTION AND ASSEMBLY PROBLEMS

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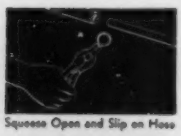
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Military History of the Western World: Volume I, From Earliest Times to the Battle of Lepanto. By Maj. Gen. J. F. C. Fuller. New York: Funk & Wagnalls Company.

FOURTEEN years ago General Fuller published a 2-volume work on the decisive battles of history. It promptly replaced the outdated work by Creasy and became the bible for students of military history. The broad sweep of the work included the Battle of Warsaw at the close of the First World War. It was a monumental achievement and climaxed the author's rightful title as the modern Clausewitz.

General Fuller's mind and pen are prodigious in their product as they are flawless in their process. Readers of this journal know his handiwork at first hand. For more than twenty-five years he has been a regular contributor to these pages (see his "What of the H-Bomb?" on page 206 of this issue).

"Military History of the Western World" is a herculean work. Volume I, reviewed here, begins with the Battles of Salamis, 480 B. C., and Plataea, 479 B. C., and ends with the Battle of Lepanto, 1571 A. D.

Volume II, now on the press, will start with the defeat of the Spanish Armada, 1588, and conclude with the Battle of Waterloo, 1815. Volume III, now in preparation, will begin with the Seven Days' Battle of the American Civil War, 1862, and end with the Battle of Leyte Gulf, 1944. Thus the entire panorama of the

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recorded history of great conflicts of mankind is included in the Fuller canvas—a sweep of such proportions that only a master craftsman would attempt to portray it and few others than General Fuller could perfect it.

General Fuller, for all his writings, has never undertaken a greater responsibility. He has met that responsibility in superb fashion. His scholarship, erudition, industry, and judgment have not been surpassed —nor will they be for many a day to come. Here Philippi, Constantinople, Hastings, Hattin, Crécy, Orleans, and Lepanto are relived and analyzed by an expert who is strategist, tactician, and litterateur.

A notable innovation in the pattern of this presentation is what General Fuller calls "chronicles." Between the description of each battle there is a brief summary of the intervening period. The preparation of these chronicles of themselves required superior scholarship.

The author and the publishers have presented to all students of military history—and that should include everybody these days—a master work of the first importance. It can guide and guard our military strategists of the second half of the twentieth century, for the lessons of history are here presented by an expert.—L. A. CODD.

(EDITOR'S NOTE.—This work is being published simultaneously in England by Eyre and Spottiswoode under the title, "The Decisive Battles of the Western World—and Their Influence upon History," 604 pages, 30 shillings.)

The Memoirs of Marshal Mannerheim. Translated by Count Eric Lewenhaupt. New York: E. P. Dutton & Company. 540 pp. $6.75.

BARON Carl Gustav Mannerheim, now at the age of 83 living in retirement in Switzerland, has given here an interesting biography of his very full life and at the same time presented the trials and tribulations of his country in a simple, concise, and readable book.

After attending the Finnish Corps of Cadets School at Hamina, until he was dismissed in the 1880's for an infraction of the rules, he attended the Nikolaevski Cavalry School in St. Petersburg, Russia. After graduation he entered the service of Czar Alexander III as an officer in the Empress Feodorvna's Chevalier Guards.

He took part in the Russo-Japanese war in 1904-1905, and in 1906 he was sent on a military mission by the Russian General Staff to travel on horseback from Russian Turkestan to Peking China, visiting all the Chinese provinces on the way.

This journey took almost two years, and the report of his travels through this

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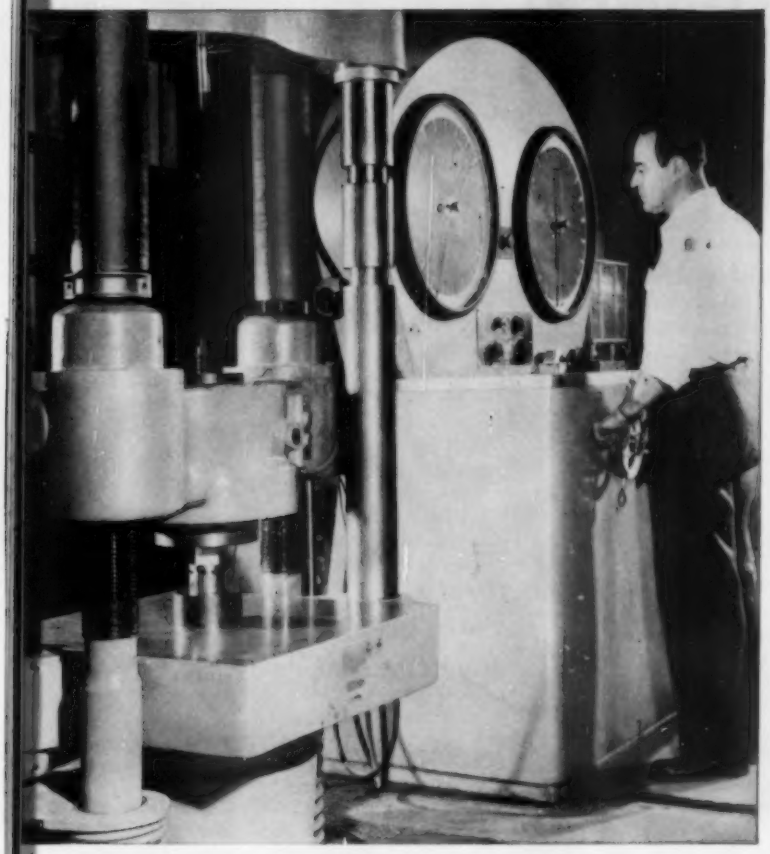

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uncharted country reads like the journeys of Genghis Khan.

The Russian Revolution of 1917 was followed by his return, after thirty years of service with the Czar, to his native Finland. He organized a Finnish Defense Corps and fought several wars of liberation for Finland.

After a term as regent, he was called to be chairman of the Defense Council during the trying period in the 1930's, and he succeeded in equipping Finland to meet the war in Europe that he knew was in the offing.

In 1939 his little country successfully fought the Red armies of Russia and in 1940 signed a favorable treaty of peace with Russia, truly a world-noteworthy feat.

Baron Marshal Mannerheim was unanimously elected President of the Republic of Finland and Head of the State in 1944 and relinquished the office in 1946 for reasons of health.

The brevity of the tactical descriptions may not satisfy the military reader who is in search of details, but the drama unfolded in this book will be enjoyed by all readers.—T. K. VINCENT.

Strategy for the West. By Sir John Slessor. New York: William Morrow & Company. 180 pp. $3.

SIR John Slessor, Marshal of the Royal Air Force, in this small book advances a thesis and many corollaries of major importance to the survival of the West. Even if many of his strongly held opinions are debatable they merit careful consideration, for he writes of things that are of greater importance than anything else in our lives today. The decisions we make now will determine our national durability.

This book goes far beyond national interests. It concerns the grand strategy of a coalition. Therefore it deals with political and economic as well as military aspects of the problems facing us in the West's conflict with Communist Russia. All our efforts, Sir John writes, must be directed "to drive militant Communism back behind its own frontiers and keep it there."

Since he deals with things to come, he makes many forecasts concerning the future of war and peace. He does this with full awareness of the risks run by the crystal-gazers who foretell military events, and the reader will do well to indulge in a little skepticism, if he recalls the startling collection in recorded history of bungled predictions concerning the probable course of warfare.

Sir John's theory is that long-range, jet-propelled, high-altitude bombers with atomic weapons are not only "the Great Deterrent" to war—they will actually pre-

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vent war. Not all conflict, for Sir John foresees minor, limited wars, like Korea; but provided there is an Anglo-American bomber force capable of counterattacking enemy airfields and other military establishments and, above all, the heart of the aggressor country, an attack on the West will be doubtful.

No large scale airborne invasions seem feasible to Sir John, nor does he believe that in a future war landing operations like Overlord will be practicable. The Navy will not be enthusiastic about his belief that if economies are to be found we can look for them there.

He believes that scientific development has helped the defense in land-air warfare (unlike air and sea-air warfare). The land mine, the recoilless antitank weapon with the shaped charge, the proximity fuze for artillery, and other devices should lead us to remake our armies.

Since this book is concerned with grand strategy, purely military considerations are only a portion of a proposed procedure. If, as the author notes, "the most potent weapon in the Soviet armory is militant Communism," it is not surprising that he recommends a stepped-up psychological offensive.

No comment of Sir John's can be more helpful here than his observation about the meaning of victory in war: "It means not merely forcing an enemy to lay down his arms and accept terms, but *being successful in creating world conditions more favorable to yourself than if there had never been a war.*"—DONALD ARMSTRONG.

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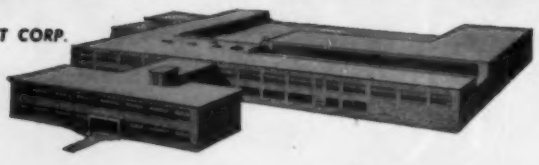

The Gun Digest—Ninth Edition. Chicago: The Gun Digest Company. 224 pp. $2.

PAST editions of "The Gun Digest" have left me amazed at the resourcefulness of the people, and especially of John T. Amber, the genial editor, who put them together. No nook or cranny of the gun lover's field of interest has been overlooked. The very best authorities in each of these have been contributors—and so continue.

Thus we find on the masthead of this latest issue the names of such stalwarts as Walter Roper (whose untimely death is also recorded), Baron Englehardt, Stephen Grancsay, Elmer Keith, Warren Page, and General Hatcher—to name but a few.

Among the special articles, Roy Dunlop contributes one of outstanding interest on gun engraving, while Baron Englehardt's continuation of his story of European proof marks represents the last word on that important subject. Of especial fascination for the cartridge collector is the facsimile reproduction of a Kynoch catalog for 1884.

The collector's section, the rifle section, and the handgun section each offer four arresting articles; the shotgun section, five. Sections on foreign firearms, cartridges, sights, and a miscellany, complete the volume.

The new "Gun Digest" is tops. I only wish I owned copies of all existing editions.—CALVIN GODDARD.

Paratrooper. By Lieut. Col. Francis X. Bradley and Lieut. Col. H. Glen Wood. Harrisburg: Military Service Publishing Company. 96 pp. $3.50.

"PARATROOPER" is a book to own and show with pride. It is stimulating to find the essential spirit of one of our services so well portrayed in both pictures and words. Those of us charged with military leadership today know how important it is to instill in our young men in uniform the basic essentials of pride in country, pride in service, and pride in organization.

"Paratrooper" not only portrays the key figures and accomplishments of paratroopers in the past but fully convinces any reader that all of the finest in military service is being preserved in the paratroopers of today.—E. P. MECHLING.

Government and Science: Their Dynamic Relation in American Democracy. By Don K. Price. New York: New York University Press. 203 pp. $3.75.

THE genesis of this timely and important collection of seven essays was an invitation from New York University to deliver the 1953 series of James Stokes Lectures on Politics. Mr. Price was also

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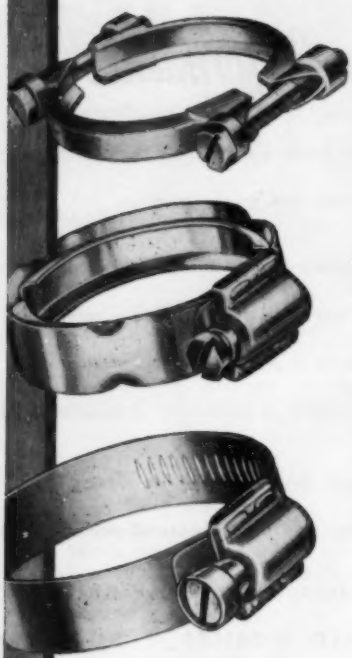

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intrigued by the notion that the development of public policy and of the methods of its administration owed less in the long run to the processes of conflict among political parties and social or economic pressure groups than to the more objective processes of research and discussion among scientific and other professional groups.

He was struck by the fact that a professional consensus, based on the findings of research of a scientific or semiscientific nature, frequently brought about the adoption of a new public policy and determined the method of its administration.

But the relationship between government and science is not a one-way street. If science has influenced government, it is equally true that government is today, by various kinds of grants-in-aid, profoundly influencing scientific developments.

While some fears have been expressed that universities are taking on so large a portion of Federal programs that academic freedom is being gravely jeopardized and that serious damage will occur in case of severe retrenchment, Mr. Price finds that there has been no organized objection from scientists and educators to the general development of Federal aid in this field.

Nobody, of course, shoots Santa Claus.

Yet a more important reason for the absence of criticism is the character of the improvised form of federalism that now governs the relations of the Federal Government and scientific institutions. This new system of relationships, based on administrative contract, not only gives support to scientific institutions that still retain their basic independence, but it also creates new ones that become equally independent.

We are indebted to Mr. Price for the pioneering exploration of a field of investigation that has been largely neglected. The author's long and varied experience in government adds a highly realistic flavor to what would otherwise be another series of ivory-tower lectures on a provocative subject.—JOHN J. O'CONNOR.

The Story of Colt's Revolver. The Biography of Col. Samuel Colt. By William B. Edwards. Harrisburg: The Stackpole Company. 470 pp. $10.

THIS is, to date, the most complete and authoritative story of the life of the brash and energetic genius whose inventive ability and productive energy combined to furnish America with one of the most important tools of her nineteenth-century progress.

Mexican and Indian alike soon learned to dread the weapon invented by this man, and the American fighting man, in or out of uniform, to appreciate its worth.

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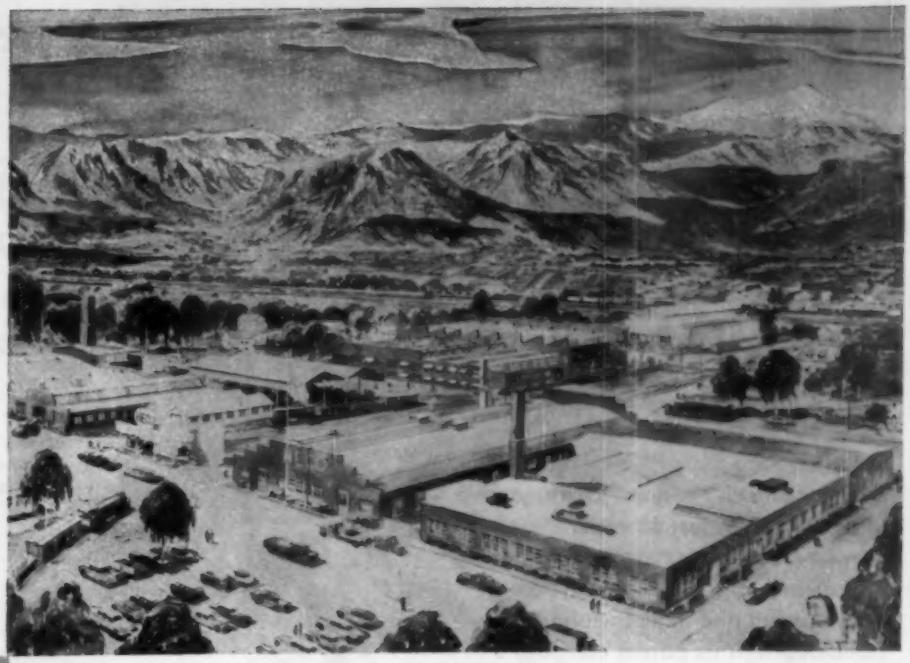

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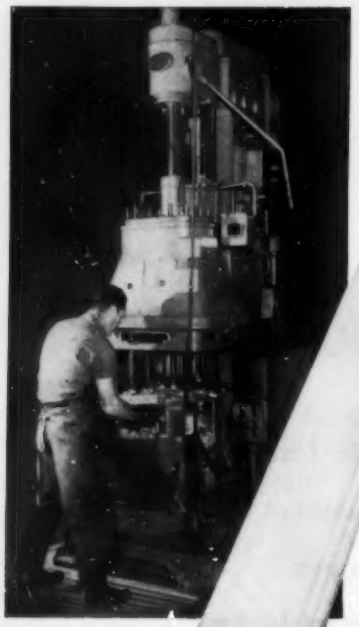

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Book Reviews

But, as with so many advanced arms, selling the Government was a herculean task. This task was Colt's life work, and it makes a fascinating story.

Mr. Edward's careful research and energy contribute much to the success of his present work. Much of it is due to his use of the facilities of the Colt Arms Company which, despite the losses of fire and the inevitable attrition of change and time, seems alone to possess the basic informative documents to fill the gaps in the record.

However, the author has not been satisfied merely to string the documents together. Though he uses a great many of them for authenticity, he has bound them up within a well-written and quite factual account of Colt and his weapon. Hundreds of illustrations enliven the text.

The story stops with Colt's death and therefore with the percussion weapon. It might be asked if a summary of the development of the Colt cartridge revolver would not have added to the volume's worth—but it is already about as hefty a book as is easily handled. Distinctly, it is a must for any student of American firearms.—F. W. Foster Gleason.

Molecular Theory of Gases and Liquids. By Joseph O. Hirschfelder, Charles F. Curtiss and R. Byron Bird. New York: John Wiley & Sons, Inc. 1,219 pp.

In recent years, scientists and engineers have been reading with interest the excellent reports issued by Dr. Hirschfelder and his associates as University of Wisconsin Naval Research Laboratory reports. These reports have attempted to summarize the present status of knowledge in the fields of equation of state and transport phenomena for personnel engaged in military research and development projects.

The series was initiated during World War II under the auspices of the National Defense Research Committee and later supported by the Bumblebee program sponsored by the Navy Bureau of Ordnance. Now these reports have been compiled and correlated into a unified book with a wider potential reading public than the limited national-defense establishments.

The book will be of most use as a reference for theoretical physicists and chemists already having considerable background in this field, and industrial engineers could find the book of considerable value in predicting bulk and transport properties of gases and liquids for which no experimental data are available.—Dr. Eugene Miller, *Ordnance Missile Laboratories, Redstone Arsenal, Huntsville, Ala.*

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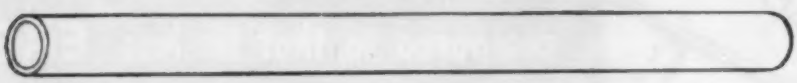

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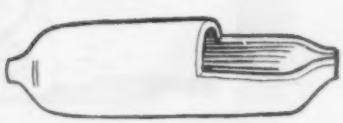
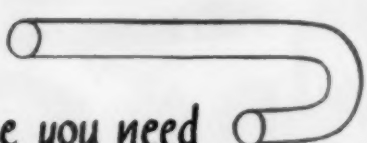


or fabricate it
into the shape you need



It can be bent, coiled, flared, brazed, beaded, annealed formed, soldered, cut, swaged, expanded...You name it! Result? You save plenty of time, money, material

And... Remember!

It can be done to the toughest of specs. After all, Wolverine has been meeting them with deliveries of millions upon millions of copper and gilding metal rotating bands. *They've got to be right!*

EST. 1916

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DIVISION OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing

Write for your copy of Wolverine's Statement of Scope . . . *today!* WOLVERINE TUBE, Division of Calumet & Hecla, Inc.
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Wolverine Trufin available in Canada through the Unifin Tube Company, London, Ontario
PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA SALES OFFICES IN PRINCIPAL CITIES
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- **N-A-X AC 9115** steel—for gas turbines and similar products requiring strength of material when operated at higher than normal temperatures up to 1000°F.
- **N-A-X 9100** series—alloy steels for carburizing and heat treated parts.

With these three N-A-X ALLOY STEELS, we offer time proven products to economically serve you.

N-A-X HIGH-TENSILE is 50% stronger than mild carbon steel with high notch toughness. Has excellent cold forming and welding properties and greater resistance to atmospheric corrosion and abrasion.

N-A-X AC 9115—a steel easily fabricated and welded by any method, maintains high strength at elevated temperatures up to 1000°F. When protected against high temperature oxidation by proper coatings, it is a worthy alternate for the higher-alloy stainless type steels for this application.

N-A-X 9100 series—a series of alloy steels with the alloying elements constant within an established range, with carbon varied to suit the hardenability and hardness desired. An outstanding carburizing steel.

GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division — Ecorse, Detroit 29, Mich.

NATIONAL STEEL CORPORATION

included.
Ordnance Storage Contract Awarded
A contract to move, clean and store more than 3,000 machine tools from Michigan, Indiana and Ohio factories to Fort Custer has been signed with Commercial Contracting Corp., Detroit, Col. Edward D. Mohlere, Detroit Ordnance District commanding officer, announced today.
Work will begin immediately, he said. Storage will be in 96 buildings scattered throughout the fort.
Mohlere said the program will save taxpayers "millions of dollars in capital equipment that might otherwise have to be replaced," and also "will cut in half the time necessary previously to go into full-scale production."

— From Detroit News, May 22

Hand CCC your "Mothball Headaches!"

We have processed more than a HALF-MILLION machine tools and industrial equipment for the U. S. Government and prime contractors since 1945.

Removing, processing, transporting and storing millions of dollars' worth of production machinery is no job for amateurs. It calls for highly specialized equipment and skills, plus constant supervision by a firm of financially responsible experts. Otherwise it can be a king-sized headache!

That's why the U.S. Government and scores of manufacturers have entrusted the handling of equipment valued at more than a billion dollars to Commercial Contracting Corporation. We have the facilities and know-how to handle anything from the most delicate precision instruments to giant presses with minimum interruption and maximum security.

If you're dreading the headache of "mothballing"—or *any* plant program involving the removal, movement or installation of machinery – let CCC do the worrying. *That's our specialty.* No matter how large or small the job, you can be confident we'll do it *quickly, expertly, economically*—just as we've served:

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CCC services, available to you individually or under one PACKAGE contract, include:

General Construction • Building Alterations • Demolition • Foundations • Machinery Installing Press Erecting • Crane and Conveyor Installing • Equipment Warehousing • Machinery Moving Steel Fabricating • Export Packaging

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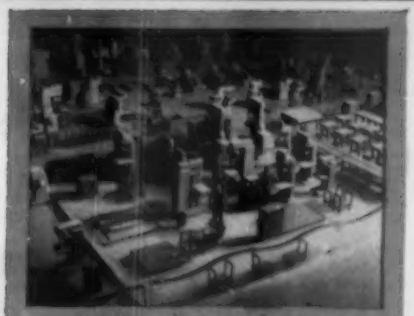
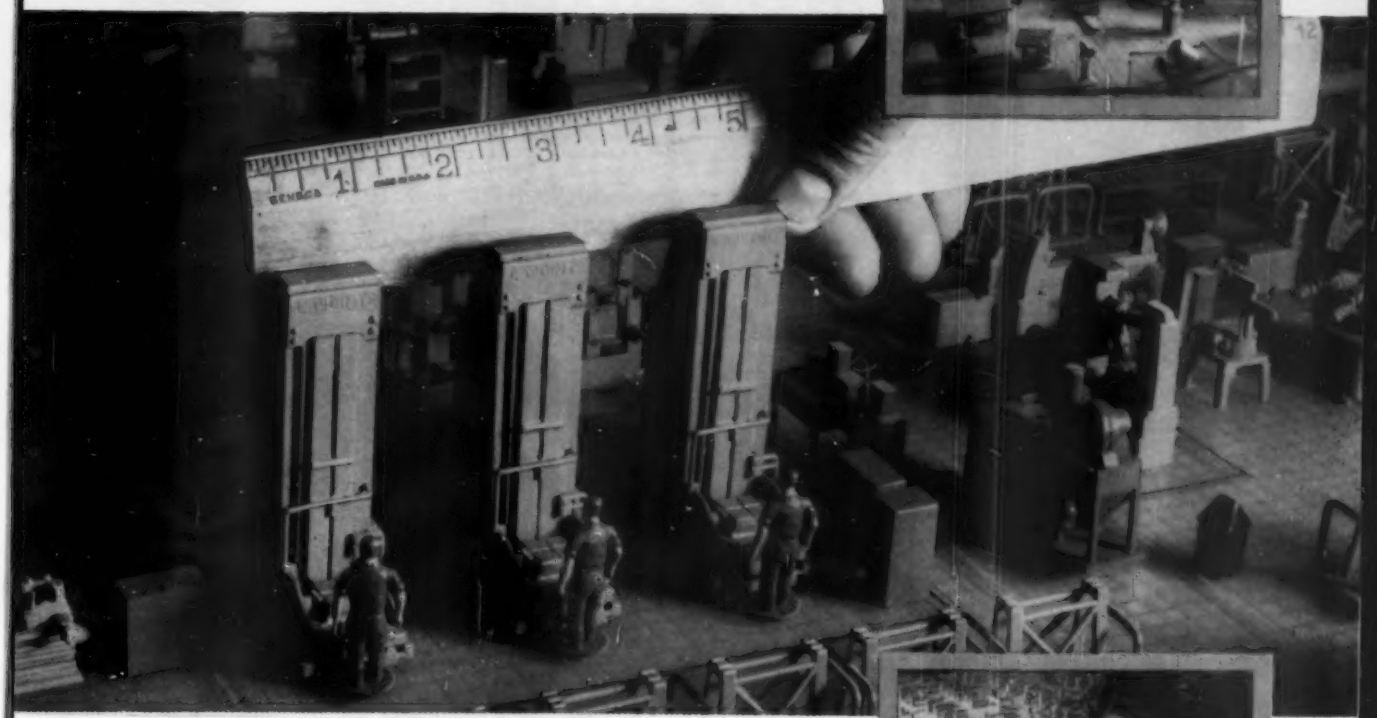
FACTS ABOUT

FAIRCHILD
Engine Division

PRODUCTION ENGINEERING





3-D . . . in miniature . . . has an important production engineering role at the Fairchild Engine Division. Scaled-down duplicates of the big production lines save countless dollars and untold man hours . . . make possible complete pre-planning before actual production of turbojet engines, auxiliary powerplants and other power products begin.

Miles of blueprints for new floor plans are eliminated. Instead, technicians simply arrange scale models to arrive at the most efficient production layout. Then, actual plant layout is set up to agree with the scale layout. Advanced techniques like this are a part of *planned* production engineering at Fairchild . . . pushing efficiency up and costs down on major projects for *all* the Armed Services.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Engine Division
FARMINGDALE, N. Y.

AIRCRAFT DIVISION, Hagerstown, Maryland • AMERICAN HELICOPTER DIVISION, Manhattan Beach, Calif. • GUIDED MISSILES DIVISION, Wyandanch, N. Y. • SPEED CONTROL DIVISION, Wickliffe, Ohio • STRATOS DIVISION, Bay Shore, N. Y.

ONE OF THE
World's Tallest Television Towers
RESTS ON 50 TONS OF SHELBY TUBING

● Rising high in the air, atop eastern Pennsylvania's Blue Mountain, is one of the tallest television towers in the world—the 1,036-foot transmission tower of Station WHUM-TV, Channel 61, Reading.

From its tapered base to approximately half way up—about 500 feet—the tower is constructed of 25-foot sections of 4-inch O.D. Shelby Seamless Mechanical Tubing —50 tons of it—fabricated by Stainless, Inc., North Wales, Pa.

Higher than the famous Eiffel Tower in Paris, the gigantic structure tapers down to a remarkably small triangular steel and concrete base, the three supporting sections of Shelby Tubing sloping into their concrete anchor, which is sunk 25 feet in the ground. The tremendous tower coupled with up-to-date television procedures makes Station WHUM-TV one of the most powerful stations in the world.

◀ THE TOWER WAS ERECTED in 25-foot sections—each section alternately painted red and white. In an 8-hour work day, the crew completed ten sections.

This is the type of application in which Shelby Seamless Tubing excels. Produced to exacting standards, it provides the very high uniformity of strength and dependability that only *seamless* tubing can give.

Shelby Seamless is available in a complete range of diameters, wall thicknesses, and analyses to meet the most exacting requirements. Call on our engineers. They are here to help you apply USS Shelby to your specifications.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
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SHELBY SEAMLESS MECHANICAL TUBING

UNITED STATES STEEL

For long life under extreme conditions of shock, vibration, corrosion, humidity and temperature

Bendix W type
HEAVY-DUTY
ELECTRICAL CONNECTOR

Here is the electrical connector designed and built for maximum performance under rugged operating conditions.

Intended for use with jacketed cable and not requiring ground return through mating surfaces, this connector incorporates sealing gaskets at all mating joints.

W-Type Bendix* Connectors also incorporate standard Scinflex resilient inserts in established AN contact arrangements.

Shell components are thick-sectioned high-grade aluminum for maximum strength. All aluminum surfaces are grey anodized for protection against corrosion.

It will pay you to remember that for the really tough jobs, where ordinary electrical connectors just won't do, be sure to specify the W-Type Connector. Our sales Department will gladly furnish complete specifications and details on request.

*REG. TRADE-MARK.

SCINTILLA DIVISION

Bendix
AVIATION CORPORATION

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Export Sales: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

Bendix

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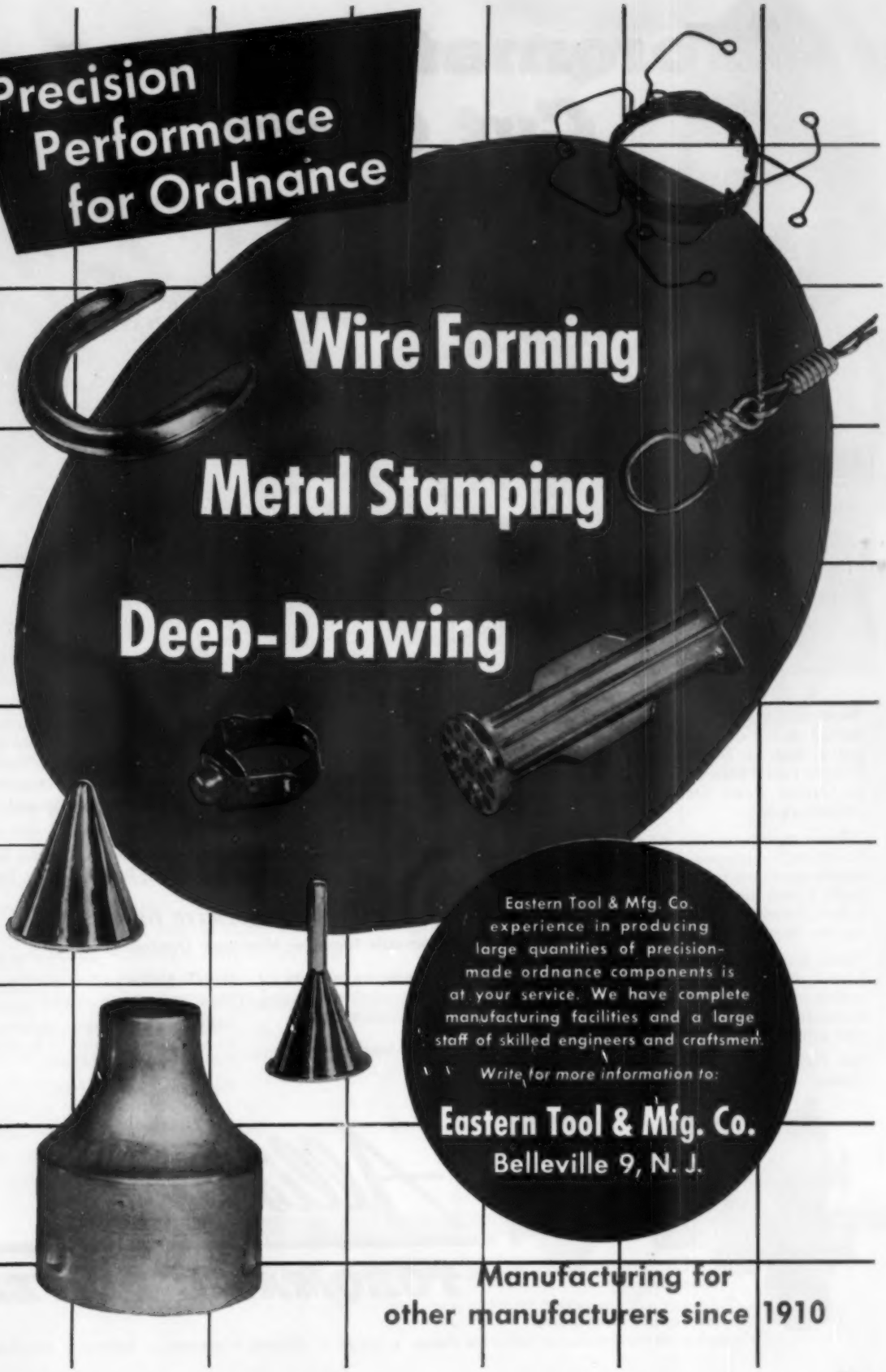

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Eastern Tool & Mfg. Co. experience in producing large quantities of precision-made ordnance components is at your service. We have complete manufacturing facilities and a large staff of skilled engineers and craftsmen.

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Manufacturing for other manufacturers since 1910

"Torqmatic Drives Cut Costs"

Heading down a rock-strewn grade with a 40-ton payload at Gavins Point Dam, this bottom-dump "Euc" easily takes the rough going with Allison's TORQMATIC DRIVE transmitting engine power.

Western Contracting Corporation started saving money when the firm put a fleet of TORQMATIC-equipped 27-yard Euclid bottom-dumps to work at Gavins Point Dam. Company officials report:

"Clutch repairs are eliminated in the TORQMATIC-equipped units because there's no clutch pedal for drivers to push. Clutch life averages 90 days in a fleet of direct-drive trucks also working for Western on this job.

"Used to lose as many as 4 drive lines a week with drivers *manually* coordinating engine and drive line on the direct-drive units . . . *never lost a drive line* with TORQMATIC DRIVES."

On TORQMATIC-equipped trucks, drivers quick-shift at full throttle—have only 3 forward speeds (instead of the usual 7 or 10) to handle all loads and grades. The converter-transmission team eliminates gearshift guess and gearbox clash. TORQMATIC DRIVES have such an excellent operating record on this job that the operator intends to specify them in future equipment orders.

If you're one of the men who's changing the face of the earth, do it better and at less cost with Allison TORQMATIC DRIVES in your units. For more information, ask your equipment dealer, manufacturer or write:

Allison Division of General Motors
Box 894W, Indianapolis 6, Indiana

ALLISON TORQMATIC DRIVES

Unbeatable Team for Maximum Operating Economy

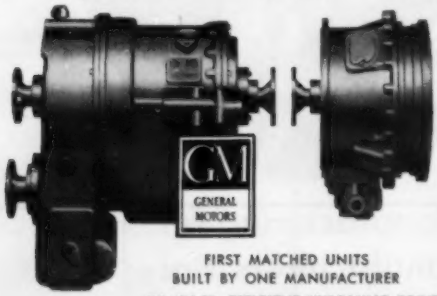
Reduces maintenance costs by absorbing shock—eliminates engine lugging—prolongs equipment life.

Holds power to load at all times—no clutch pedal to push—no gearshift guess.

Quick-Shifts at full throttle with finger-tip hydraulic control.

Only torque converter-transmission team designed to work as a unit and built by one manufacturer.

Cuts driver training costs.



FIRST MATCHED UNITS
BUILT BY ONE MANUFACTURER

Allison

TORQMATIC DRIVES

COMPACT, EFFICIENT HYDRAULIC DRIVES FOR CRANES • TRUCKS • TRACTORS • SCRAPERS • SHOVELS • DRILLING RIGS

how much less can airpower cost?

With rapidly mounting pressure from business and the public for tax relief—and with the airpower requirements of our security program heavier than ever before—what is our industry doing to lower the cost of taxpaid airpower?

How much less should—and can—our airpower cost?

We at Martin are daily developing dollar-and-cents answers to that explosive question, in every phase of design, engineering and production.

Shown above is a sample from the record of the U.S.A.F. Matador B-61 Pilotless Bomber, top-rated major weapon which was designed, engineered and built, from concept to acceptance, without benefit of precedent.

The stabilizer of the Matador consists of 13 parts. Shown beside it are some of the more than 3,000 parts which would be required to produce the stabilizer for a multi-engine transport by traditional methods.

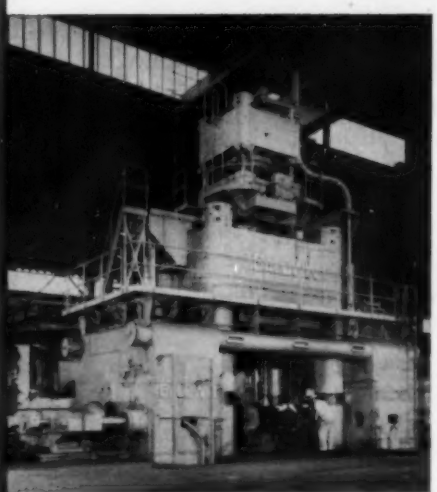
What of the Matador itselt? New Martin processes and methods are producing this major weapons system for a fraction of the cost-per-pound of equivalent piloted aircraft—and to performance specifications more exacting than most.

The dollar-and-cents payoff of Martin Systems Engineering is one of the most challenging stories in the aircraft industry today.

You will hear more about Martin!

MARTIN

BALTIMORE · MARYLAND



These propeller blanks were forged on Cameron's 26,000 ton multiple ram split-die ferrous metal forging press.

ANOTHER LARGE SIZE AND INTRICATE SHAPE IS FORGED

Pictured above are 64" aircraft propeller blanks now being forged from steel, rough machined and cold pressed at Cameron Iron Works, Houston. These forgings, free of inclusions and crevices, are then drawn and shaped by the prime contractor into propeller blades.

You too may have the need for forgings which will result in improved quality products at lower manufacturing costs.

FORGE AND ORDNANCE DIVISION

Cameron

IRON WORKS, INC.
HOUSTON, TEXAS

Write today for further information.

SERVING the ARMED FORCES ..of the U.S.A. is our most important Business!

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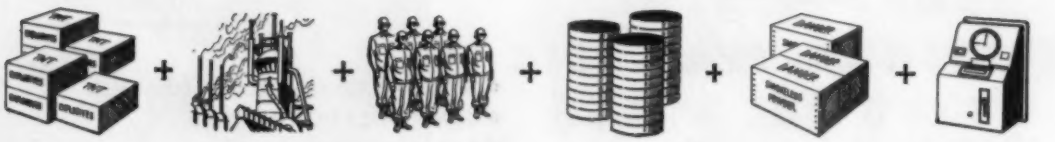
What It Takes to Fire a Howitzer Barrage



$2800.00 An Hour and worth every penny of it! Even though the cost of freedom might seem staggering in terms of a single howitzer barrage—in terms of civilian effort, our freedom is the biggest bargain in the history of mankind. On an average we work less than two hours a day to pay the cost of defending our rights and privileges as free men and women.

Skill and *speed* in our work keep freedom a part-time job... enables us to enjoy a richer spiritual and material life. But even if freedom were a *full*-time job, it would be well worth the effort as millions of enslaved people would testify... if they could.

Above figures are given with due regard to security.

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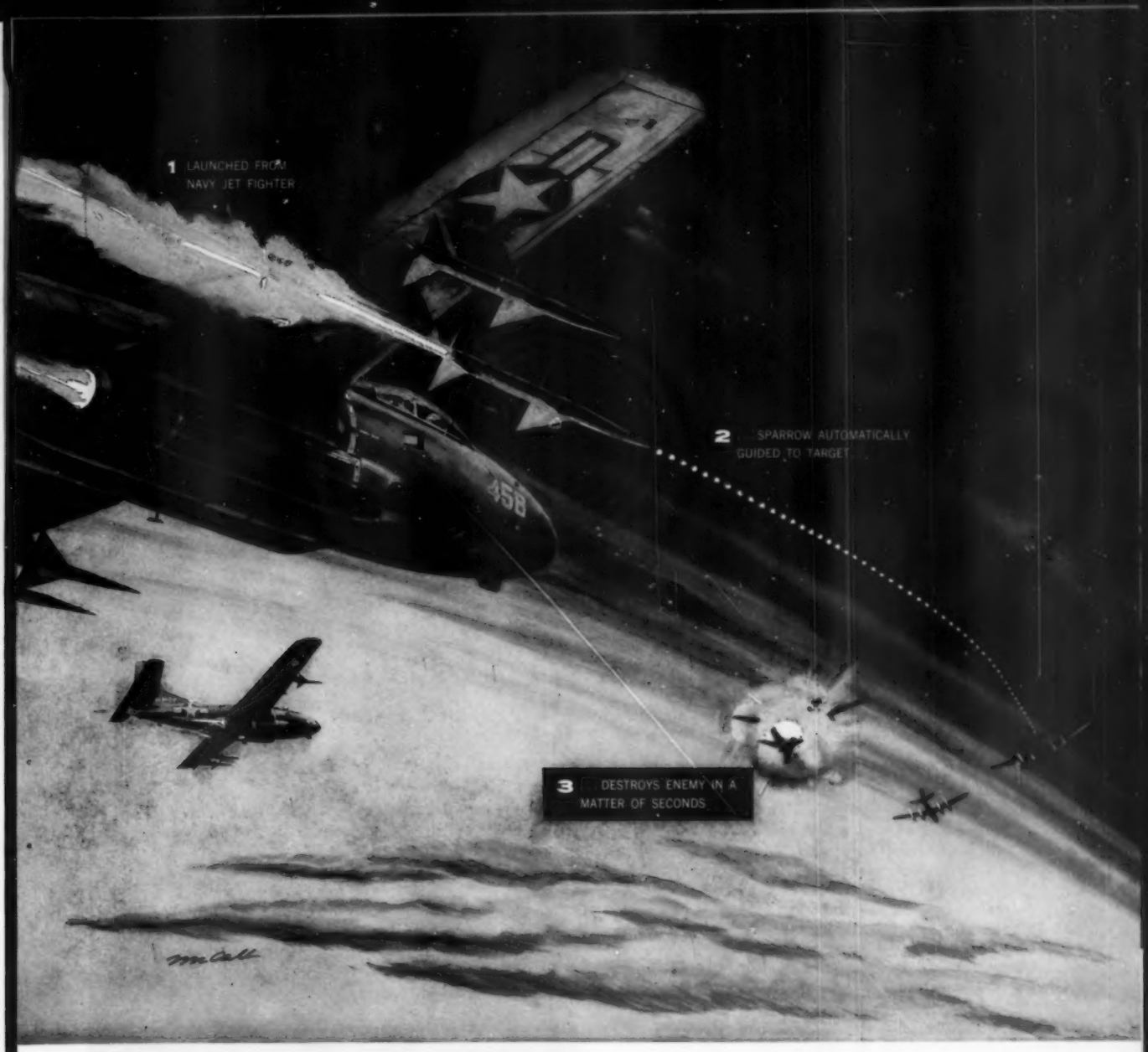
AMF does it better—automatically!

CREATORS AND PRODUCERS OF ELECTRONIC AND MECHANICAL EQUIPMENT FOR THE ARMED SERVICES: Radar antennae systems • automatic loaders for Army and Navy weapons • elevation and azimuth mechanisms • cooling fans for Army tanks • airplane parts • mobile ovens • electronic training devices • naval ordnance • rolled and welded steel products • shell components • silver-zinc batteries • special military projects.



Carrier Based Jets to have Radar Guided Missiles

NAVY'S AIR-TO-AIR SPARROW 1 IN PRODUCTION

THE STORY BEHIND THE STORY

■ On May 12, newspapers from coast to coast carried headlines like the ones above, announcing the Navy's newest weapon of defense—Sparrow I—and the beginning of volume production for operational use in the fleets.

■ Ahead of these headlines were 7 years of intensive cooperative effort shared by the Navy's Bureau of Aeronautics and Sperry.

■ Originally designated project HOT SHOT, Sparrow began back in 1947 when the Bureau of Aeronautics assigned to Sperry the full responsibility of creating an entirely new air-to-air missile system. It had to be light and compact — so multiple units could be carried by fighter-type jets. It had to be deadly accurate — capable of outmaneuvering the swiftest bombers an enemy could produce. And it had to be practical—suitable for large-scale production.

■ The rocket-powered, radar-guided Sparrow I, coming off the production lines here and at the new Sperry Farragut plant in Bristol, Tennessee, meets these requirements—and more. It embodies the proved features of more than 100 different missiles designed, constructed and tested during a 7-year period — and the finest brains of an organization that has devoted more than 40 years creating and manufacturing automatic flight control and fire control systems.

SPERRY GYROSCOPE COMPANY

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Everyday more and more service shipments go **WIREBOUND**

An ever increasing number of suppliers are taking advantage of improved Military and Federal specifications so that they may obtain the benefits of Wirebound containers for Armed Service shipments. They've found Wirebound box manufacturers well qualified to supply containers that meet government requirements for parts, equipment, over-packs, food and hundreds of other uses. Wirebound plants throughout the country are up-to-date on Armed Service shipping specifications and have the experience, technical know-how and testing facilities to produce the best container for each use. Why not check with your Wirebound supplier or write for full information!

Wirebound Box Manufacturers Association
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75 WIREBOUND BOX PLANTS are ready to serve you!

Bendix power

STEERING AND BRAKING

sets new standards of driving ease and safety

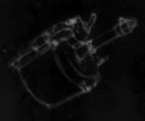
Today's most wanted power features for cars and trucks

Bendix * low pedal POWER brake

Specified by more car manufacturers than any other make, Bendix Low Pedal Power Brake makes possible quick, sure stops by merely pivoting the foot from stop-and-go controls. No need to lift the foot and exert leg power to bring the car to a stop. Result—more driving comfort, less fatigue and greater safety!

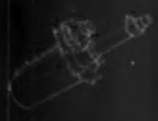
Bendix * POWER steering

Because Bendix Power Steering is of the linkage type, vehicle manufacturers find it especially adaptable for production line installation, without extensive engineering changes. Manufacturers can now meet the increasing demand for power steering more efficiently and more economically with Bendix Power Steering.



Bendix HYDROVAC* POWER brake

With over four million in use, the Bendix Hydrovac is by all odds the world's most widely used power brake for commercial vehicles. This overwhelming preference for Hydrovac is a result of sound engineering design, exceptional performance, low original cost and minimum service upkeep.



Bendix AIR-PAK* POWER brake

With one simple compact unit, Bendix Air-Pak combines all of the well-proven advantages of hydraulic brake actuation with an air brake system. An important advantage of Air-Pak is that brakes can be applied by foot power alone when braking is required before air pressure builds up or if it should fail for any reason.

*REG. U.S. PAT. OFF.

Prospects are easier to sell and owners are better satisfied with cars equipped with Bendix power steering and braking.

For example, the Bendix Low Pedal Power Brake is by all odds the most popular and best proven power brake offered by any passenger car manufacturer today, and vehicle manufacturers can quickly and economically adapt the popular Bendix Power Steering to their present design without extensive engineering changes.

For truck manufacturers and operators, Bendix Hydrovac and Air-Pak have long been overwhelming favorites in the field of power braking for commercial vehicles.

That's why if you build, buy or sell passenger cars or trucks, it will pay to make sure they are equipped with Bendix power braking and steering.

Bendix Products Division

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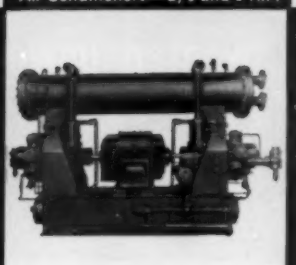
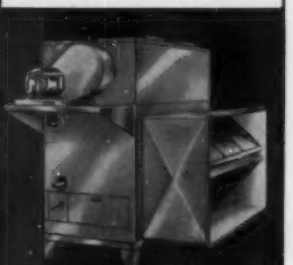
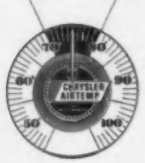

Compressor, 3 to 125 H.P.


Air Handling Unit

Many factors affect the wise choice of air conditioning. First cost, operating cost, space available, individual control, required building alteration and maintenance are all important factors.

That's where Chrysler Airtemp comes in! Because of a COMPLETE line, we can be certain you get the BEST answer to your problem.

LIVE IN THE Comfort Zone



Through a wholly-owned subsidiary, Airtemp Construction Corporation, we can also put you in touch with a reputable contractor or consulting engineer in your area, who can survey your needs and see that the correct Chrysler Airtemp equipment is applied.

CHRYSLER AIRTEMP

HEATING • AIR CONDITIONING
FOR HOMES, BUSINESS, INDUSTRY
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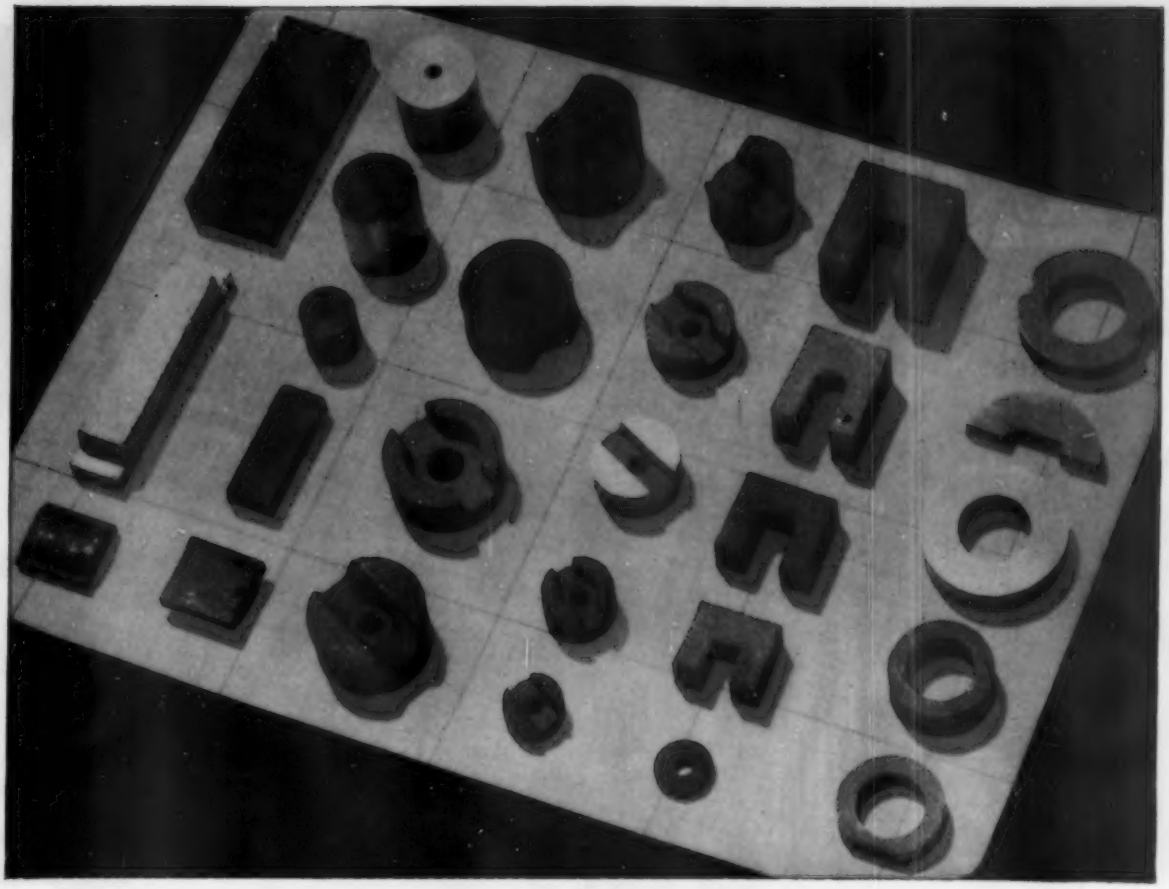
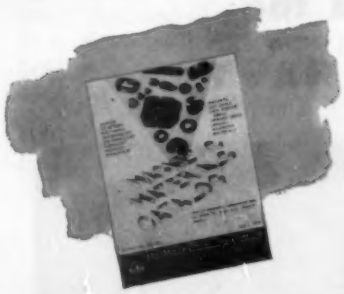


Page-full of ideas for you on *Sintered Magnets*



"MAGNETIC MATERIALS CATALOG"

Write for your copy

Contains handy data on various types of Alnico Magnets, partial lists of stock items, and information on other permanent magnet materials. Also includes valuable technical data on Arnold tape-wound cores, powder cores, and types "C" and "E" split cores in various tape gauges and core sizes.

ADDRESS DEPT. 0-9

"OFF-THE-SHELF" ITEMS or SPECIAL SHAPES to suit your needs

Magnets of sintered Alnico offer endless opportunities to designers who need their useful combination of self-contained power and small bulk. A wide range of sintered Alnico shapes are carried in stock for quick shipment. Special shapes to meet an individual design need can be developed, where the quantity required is large enough to justify the tooling costs. Arnold sintered permanent magnets are fully quality-controlled and accurately held to specified tolerances. ● *We'll welcome your inquiries.*

W&D 5280

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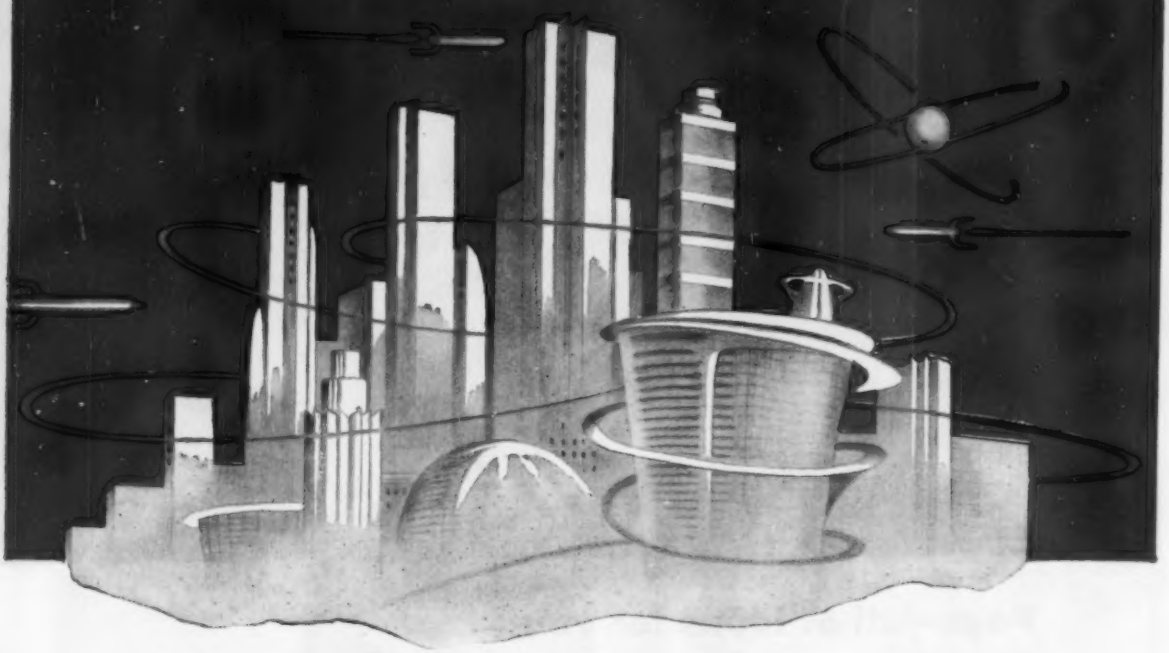

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Has Consistently Served the
ARMY • AIR FORCE • NAVY

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Highly skilled technicians, extensive engineering and chemical laboratories and over 350,000 square feet of plant capacity combine to make Borg a dependable supplier wherever precision and production are required.

Typical Borg Products

- Electrically Wound Automotive Clocks and Time Instruments
- Mechanical Time Fuzes
- Fuze Timing and Regulating Equipment
- Aircraft Instruments
- Precision Multi-Turn Potentiometers
- Custom-Built Electronic Equipment
- Frequency Standards
- Deep Pile Fabrics

THE GEORGE W. BORG CORPORATION • DELAVAN, WISCONSIN

PLANTS: Delavan, Wisconsin; Chicago, Illinois; Janesville, Wisconsin; Jefferson, Wisconsin

V & O AUTOMATION
is a military tradition

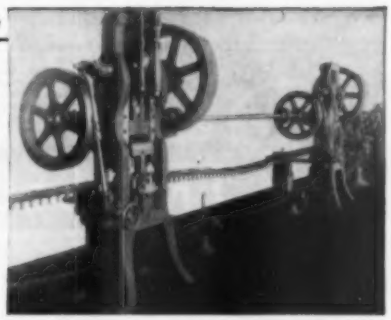
The V & O Shell Trimmer, a traditional ordnance machine, offers improved models for the needs for today.

The first V & O machines were designed because industry needed presses that could operate automated tooling. This was away back in 1893. Since then V & O automated equipment has speeded ordnance production through three major wars and plenty of other military troubles. It is doing so today. V & O automation has become a military tradition.

The V & O shell trimming, thread rolling, knurling and beading machine is an example. Earlier versions were used in World War I. It fully came into its own during World War II. Improved models are being sold right now wherever ordnance men want to thread, bead, trim, knurl or curl thin sections. Metals up to 0.140 inch thick can be trimmed. The machine is sturdy, high precision, easy to operate.

Security forbids us to reveal most of the high precision highly automated ordnance equipment we are making. But if you want automation that "has more than it takes" then just knock on our door.

V & O established the tradition of the use of automation for the production of ordnance parts.

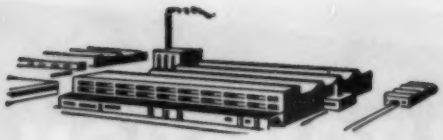


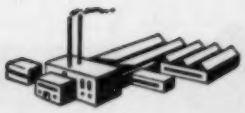
THE V&O PRESS COMPANY

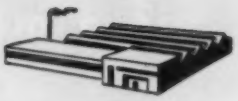
DIVISION OF EMHART MFG. CO. **HUDSON, NEW YORK**

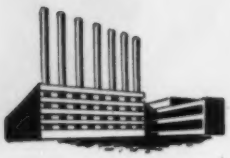
BUILDERS OF PRECISION POWER PRESSES AND FEEDS SINCE 1889

65th Anniversary









PRODUCTS and FACILITIES Serving Many Industries

Pressed Steel Car Company offers a broad range of products and services available to industry throughout the world. Alert to new processes and technological advances, Pressed Steel Car Company throughout the years has maintained a reputation for more efficient, higher quality products.

ALL OUTSTANDING PERFORMERS — ***these products range from . . . . . .***

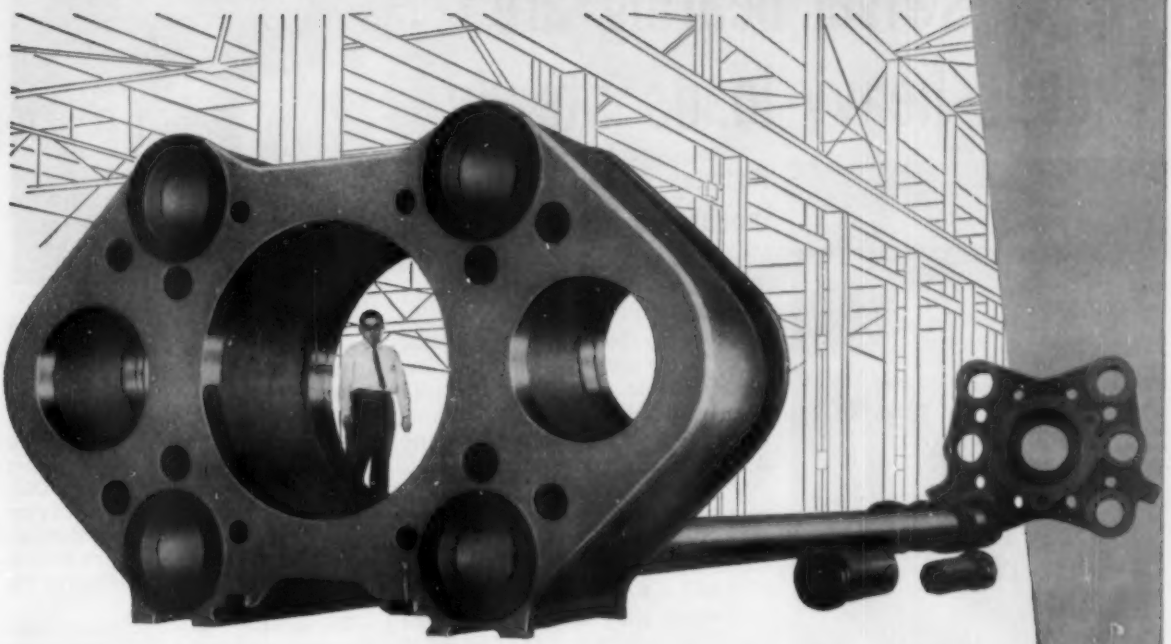
- Locomotives and trackwork to cookware
- Agricultural and farm machines to milk cans
- Railroad and industrial cars to oil pumping machinery
- Engine lathes and conduit fittings to steel tanks
- Power plants to cellular laminated containers and shelters

Products to Serve Industry...Farm...and Home . . . . . • Industrial Railway Cars for agriculture, mining, construction, factory and mill service • Permanent and Portable Industrial Railway Track Equipment • Locomotives for mainline switching and all industrial railway service • Clay, Brick and Tile Machinery • Railway Inspection and Gang Cars • Weed Burners • Unistrut Metal Framing Hydraulic Pumping Units • Precision Deep Well Plunger Pumps • Steel Sucker Rods • Engine Lathes • Aircraft Landing Gear Shock Struts • Precision Gears & Gear Mechanisms • Dairy Cans & Equipment • Self-Closing Receptacles • Permanent Cookware • Farm Holding Tanks • Storage Hoppers • Alloy Steel Containers • Oil Storage Tanks • Rendering and Softening Tanks • Agitators • Smoke Stacks • Dust Collectors • Coal and Ash Hoppers • Lock Nuts & Bushings • Couplings & Connectors • Fittings & Electrical Accessories.

New York
Chicago
Los Angeles
Honolulu
London
Mexico City
Manila
San Juan

PRESSED STEEL CAR CO., INC. 6 No. Michigan Ave. Chicago, Illinois

WORLD'S LARGEST Horizontal Steel EXTRUSION PRESS

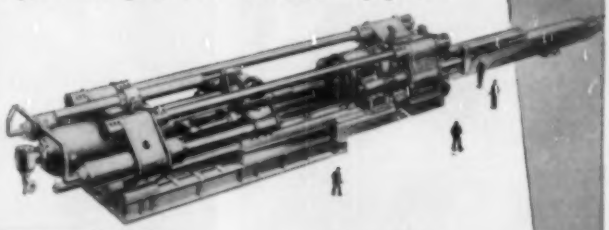


Joint U.S.A.F. Air Materiel Command — Curtiss-Wright Development Designed to Speed U.S. Industrial Production

Completed on schedule after four years of intensive teamwork development, the world's largest horizontal steel extrusion press is now being installed at the Metals Processing Division of Curtiss-Wright at Buffalo, N. Y.

This 12,000-ton press, designed and built by the Loewy Construction Company, is capable of extruding 9,000 lb. billets to 40 foot lengths. It can handle steels, titanium, or non-ferrous alloys, and is supported by full supplementary processing equipment and a die shop — plus a staff of experienced metallurgists and product design engineers.

Created as part of the government's defense program, this giant press will, by January 1, 1955, be at the service of American industry. Design and industrial engineers are invited to consult with Curtiss-Wright on availability of this new tool in solving problems and advancing production goals beyond the capacities of conventional equipment.



CURTISS-WRIGHT

CORPORATION • WOOD-RIDGE, N. J.

YOUNG MEN!
JOIN THE U. S. AIR FORCE

Investigate Career Opportunities
At Your Nearest Recruiting Office

MATERIALS-HANDLING NEWS

★ Panel Discussions by Bassick, World's Largest Manufacturer of Casters and Floor Protection Equipment ★

Bigger swivel bearing area keeps heavy loads steady

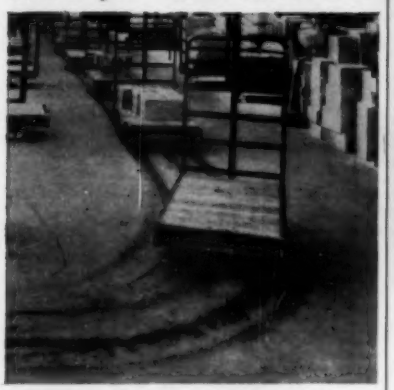
Reduces raceway wear, gives longer life, easier swiveling

Important in caster design is the diameter of the main swivel bearing and balls.

The larger this area, the greater the safety factor with proportionately less wear and tear on the caster. Avoid premature caster failure by specifying Bassick's — all have extra-quality design features. The Bassick series "99" quality, double ball bearing casters have a main swivel bearing diameter at least 1⅛ inch greater than the wheel tread width — for easier swiveling and *more-for-the-money* service.

Compare these dimensions with the casters you now use. Your best bet in the long run is Bassick's — they roll and swivel easier and last longer under hard service.

Dripping grease harms floors, boosts your maintenance costs



Sights like this can be a thing of the past in your plant, now that Bassick has perfected its new "3D" caster — no Drip, no Dirt, no Drag. Floor surfaces and rubber wheel treads are safe from damage by leaking lubricant because exclusive Bassick design features seal in grease, seal out dirt or other foreign matter. Write for new catalog sheet 3D99-53.

File test shows extra hardness of Bassick swivel bearing parts

If file bites into raceway surfaces of casters you now use, better think about buying Bassick. Double ball bearing swivel parts of all Bassick cold-formed steel casters are full case-hardened to 15N90 Rockwell. They'll pass your test with flying colors, pay off for you in extra years of wear.

1954, meet 500 B.C.!

U. S. Army Photograph

This striking photo does more than compress history into a single vivid shot of old and new crossing paths in the Orient.

For the lumbering ox-cart with its tremendous wooden wheels isn't much more out of date than some materials-handling systems we've seen in use today. Old-style, inadequate casters are about as far behind Bassick's new 16″ "Floating-Hub" caster (below) for 20-mph service, for example, as the ox-cart is behind the airplane.

The safest way to protect cargoes susceptible to shock damage during transport is through use of Bassick's "Floating-Hub" shock absorbing casters and wheels. Write for new "Floating-Hub" catalog FH-53.

New 20-mph caster.

Modernize with Bassick

Your Bassick industrial distributor is the man to see for facts and figures on the most up-to-date line of shock-absorbing and conventional casters. Or you can write to Bassick direct.

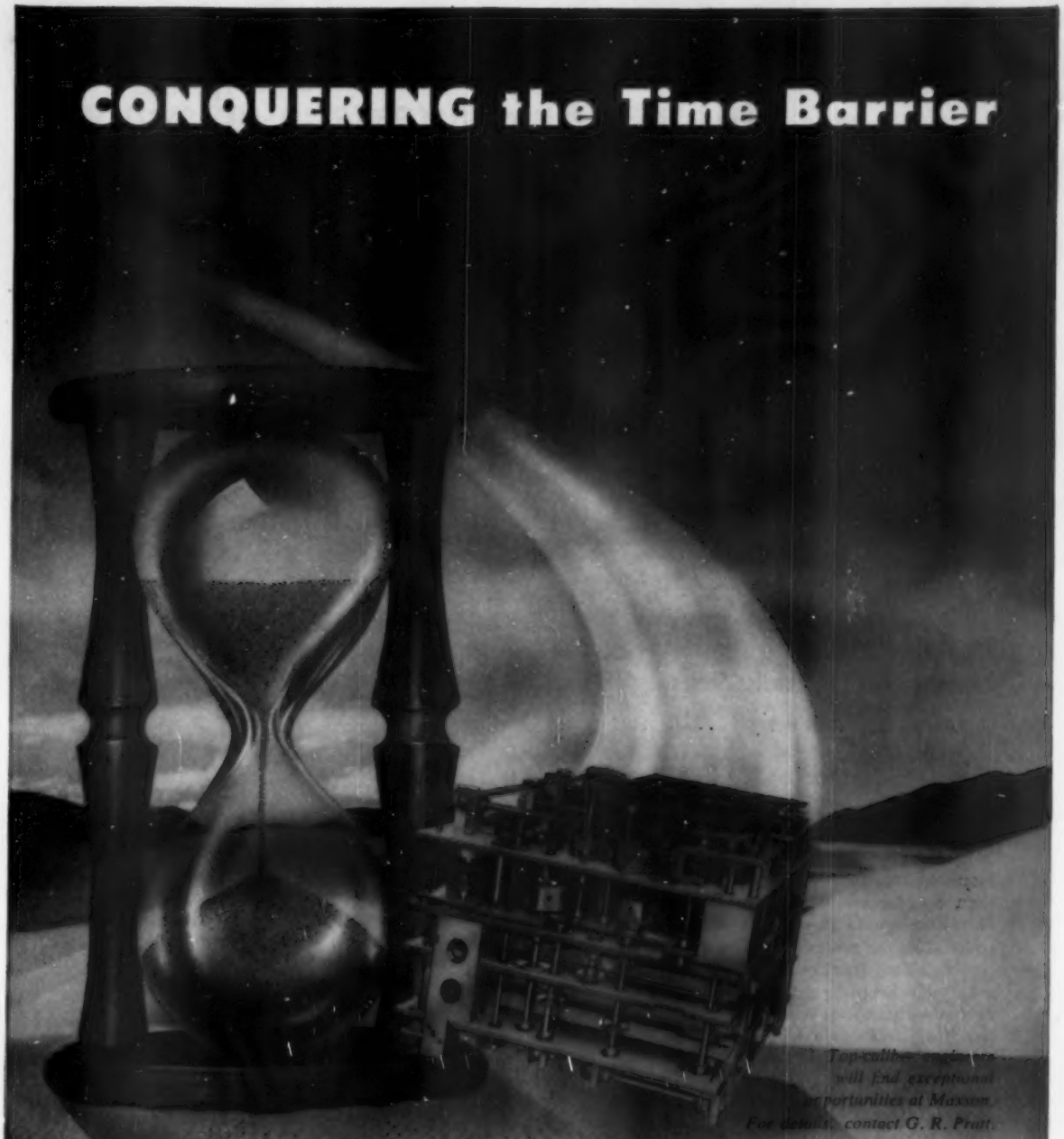
THE BASSICK COMPANY
Bridgeport 2, Conn.
In Canada:
Belleville, Ont.

Bassick
A DIVISION OF
STEWART SW WARNER

MAKING MORE KINDS OF CASTERS . . . MAKING CASTERS DO MORE

75 YEARS OF CASTER LEADERSHIP

CONQUERING the Time Barrier



Top-caliber engineers will find exceptional opportunities at Maxson. For details, contact G. R. Pratt.

COMPUTERS translate split-second decisions into instant action beyond any human ability . . . in bombing, in fire-control, in navigation. Maxson has been developing and building these computers for nearly twenty years.

MAXSON develops and manufactures systems, subsystems, and components in armament, navigation, electronics, and special devices.

Ask for facilities report.

MAXSON

THE W. L. MAXSON CORP.

460 WEST 34th STREET, NEW YORK 1, N. Y.

Plants at Old Forge, Penn. and Long Island City and New York, N. Y.

IT WORKS WONDERS IN MATERIALS HANDLING-

300 to 400% increase in efficiency

75% decrease in handling costs

One Truck-Mounted
Dempster-Dumpster Handles Scores
of Containers... All Designs... All Sizes

With the Dempster-Dumpster System, one truck-mounted Dempster-Dumpster accomplishes more than several conventional dump trucks. You eliminate trucks standing idle. You eliminate re-handling of materials. You eliminate loading crews. You increase efficiency, sanitation and good plantkeeping with this Dempster-Dumpster System—the lowest cost method of bulk materials handling ever devised.

It's like having one truck with scores of bodies. One truck-mounted Dempster-Dumpster serves scores of detachable containers. These containers range from 2 to 21 cu. yds. capacity for use with recommended type Dempster-Dumpsters. Each container is designed to suit the materials to be handled—be they solids, liquids, dust, bulky, light or heavy. You simply place these containers at convenient materials accumulation points outside or inside buildings. As each is loaded, it is picked up, hauled and dumped (or load set down intact). Entire operation is handled by hydraulic controls in cab by only one man, the driver.

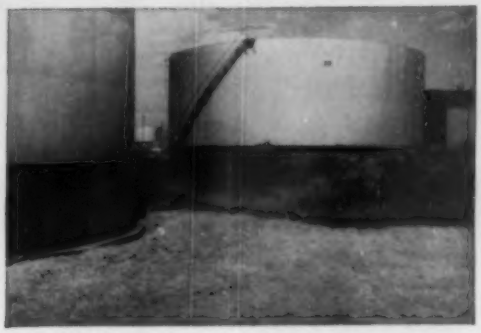
The list of manufacturers using the Dempster-Dumpster equipment reads like the "Who's Who Among the Nation's Leading Manufacturers". We mention this simply to point out that dozens of the nation's oldest and most successful firms use the Dempster-Dumpster System because of its efficiency and tremendous savings. Write to us now for complete information. Manufactured exclusively by Dempster Brothers, Inc.

Representatives in principal cities throughout the United States, Canada and foreign countries. There's one near by to serve you promptly.

DEMPSTER BROTHERS, 994 Shea Bldg., Knoxville 17, Tennessee

1. "Telvar" W has extra-long residual action. Track on right was treated in April; photograph was taken in August. Ideal for sidings, around loading docks, etc.

2. Note the thorough weed control under and around this security fence and power substation.



3. Fire hazards are reduced around oil storages and pipelines from thorough, long-term weed control with "Telvar" W.

Kill weeds with Du Pont "Telvar" W *Weed Killer* —long residual action lasts all season

HERE'S a new, low-cost way to solve your weed control problems. Just one application of "Telvar" W can get rid of unwanted vegetation for a full growing season or longer. This powerful weed killer works through the roots . . . and remains in the ground to prevent regrowth. "Telvar" W keeps storage and working areas clear, neat and accessible . . . kills vegetation that may cause a fire hazard or a cover for vermin.

SAVES MONEY, TIME AND WORK . . . One spray usually does the job . . . repeat applications are seldom necessary. No bulky chemicals to handle or store. Just 1 to 1½ pounds per 1000 square feet (40 to 60 pounds per acre) will do the job.

EASY TO USE . . ."Telvar" W is a wettable powder, ready to mix with water; can be applied by machine equipment or ordinary knapsack sprayer. It doesn't corrode metals, is non-flammable, has unusually low toxicity and it is non-volatile.

IF YOU DON'T HAVE EQUIPMENT to apply "Telvar" W, a custom sprayer will do the job for you. In fact, you may want to take advantage of his year-round service.

On all chemicals always follow directions for application. Where warning or caution statements on the use of the product are given, read them carefully.

MAIL THIS COUPON FOR FREE BOOKLET

E. I. du Pont de Nemours & Co. (Inc.)
Grasselli Chemicals Department, Rm. 4026
Wilmington, Delaware

☐ Please send me your booklet describing low-cost weed control with "Telvar" W. ☐ Send me the name of my nearest supplier. ☐ Give me the name of a near-by custom sprayer.

Name_____

Firm_____

Position_____

Address_____

City_____

DU PONT TELVAR W
REG. U.S. PAT. OFF. TRADE-MARK

weed killer for low-cost weed control

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

NOMINATION for MEMBERSHIP

in

The American Ordnance Association

A national society of American citizens dedicated to the advancement of industrial preparedness through the diffusion of Armament knowledge

To: The Secretary
American Ordnance Association
Mills Building, Washington 6, D.C.

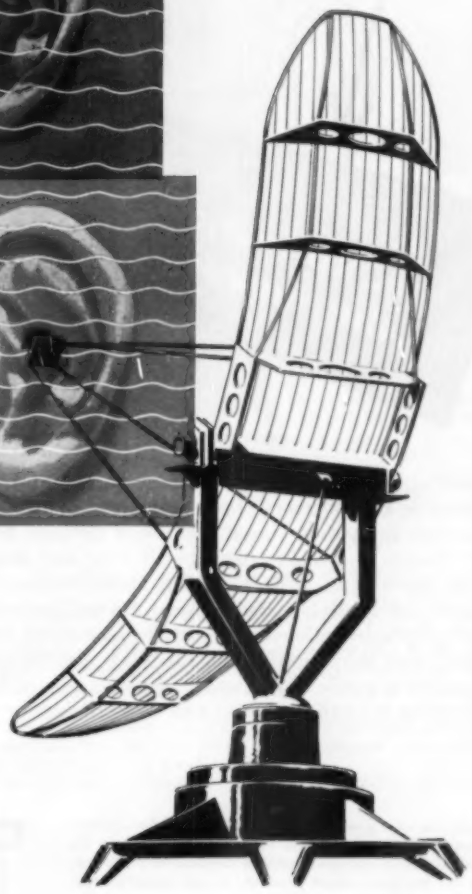
I nominate _____
(Please print name of nominee)

_____ *for membership in the Association,*
(Street address) (City, Zone, State)

and enclose annual dues: ☐ *$4.00 for one year, or* ☐ *$10.00 for three years.*
(Please check one)

Name of Nominating Member _____

HEARING AID
for long range listening



Surprise attack? Not with this vigilant hearing aid to search out the enemy, furnish data to compute distance, height and speed—sound an early warning.

Crosley is developing, designing, building and testing complete radar systems for airborne, shipboard and ground stations—all vigilant hearing aids for long range listening.

And in Crosley's flexible engineering and manufacturing facilities, Military demands meet quick response—prompt deliveries.

"Right and On Time", an illustrated brochure describing Crosley facilities for Military production, is available to Procurement Agencies and defense contractors. Be sure to write for your copy today, on your business letterhead.

CROSLEY

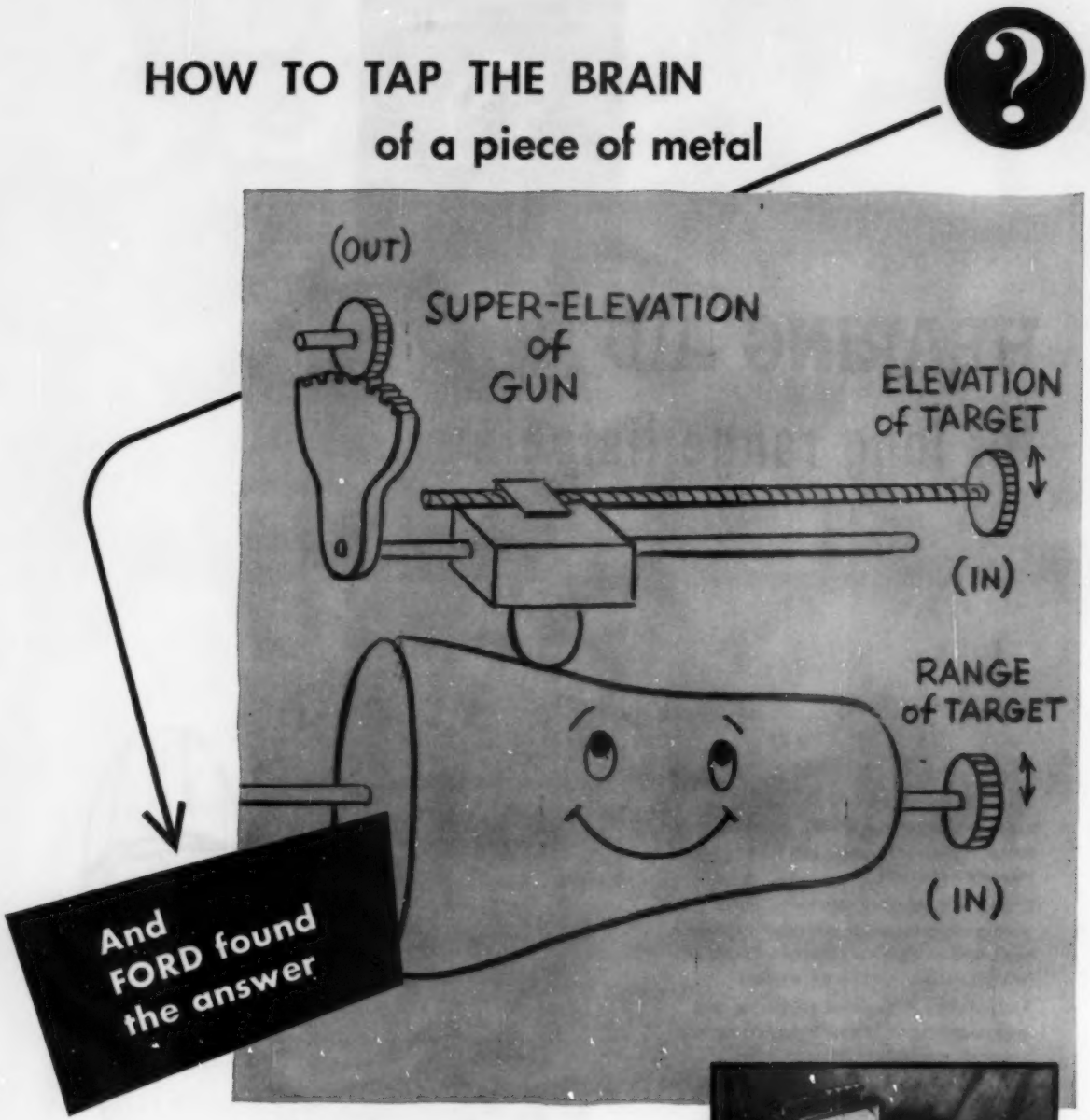
GOVERNMENT PRODUCTS

DIVISION OF AVCO MANUFACTURING CORPORATION

CINCINNATI 15, OHIO

ENGINEERS: Constant expansion of long-range research and development defense contracts in electronics, electro-mechanical devices and fire control systems increases opportunities for highly skilled engineers. Contact our Director of Engineering.

HOW TO TAP THE BRAIN
of a piece of metal



In making computers, such information as mathematical functions can be stored in a precision-cut cam, thus allowing its follower to be displaced in accurate reply to the input position of the cam. Ford Instrument Company designs and makes cams of all sizes and shapes to achieve these results. To manufacture such cams with the precision demanded, the engineers of Ford Instrument have devised remarkable automatic machines which, by following a carefully plotted ink line on a roll of paper, cut the exact shape into the metal. Then, careful point-by-point checks, sometimes as many as 2000 measurements, insure finest accuracy.

If you have a cam problem—call on Ford Instrument Company.

You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

28

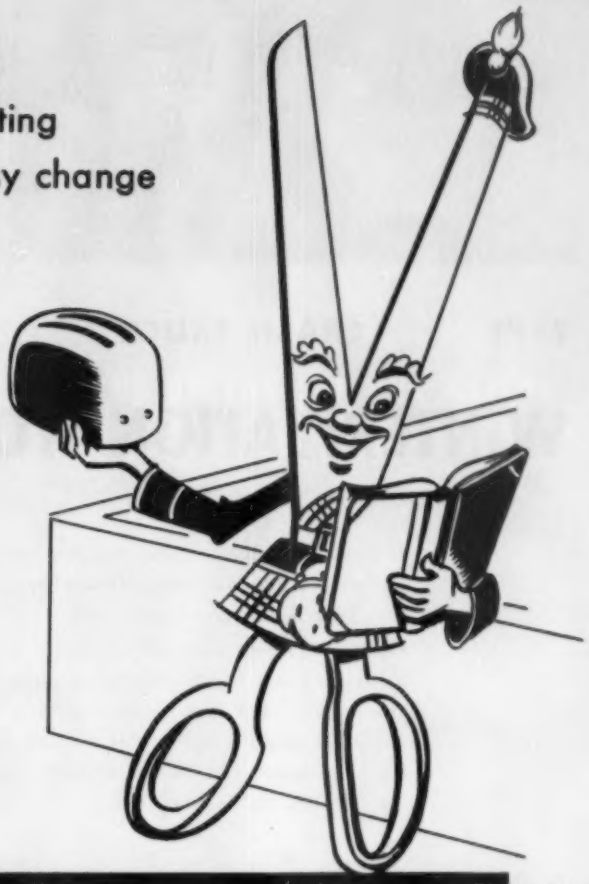
FORD INSTRUMENT COMPANY

DIVISION OF THE SPERRY CORPORATION

31-10 Thomson Avenue, Long Island City 1, N. Y.

Plating output per tank doubled—at a saving

"Mr. Cost Cutter" shows how plant gains big chromium plating production advantage by easy change



High quality toasters and waffle irons tell a startling story of chromium plating improvement. When using the ordinary chromium plating solution, this well known appliance-producer's power costs were 0.20¢ per sq. ft. of plated surface.

United Chromium then pointed out the advantages of working with the Unichrome SRHS Chromium Bath—a self regulating high speed solution. The bath was installed—and results proved the point.

With SRHS chromium plating, power came to only 0.08¢ per sq. ft. plated—a *60%* reduction in cost.

But even more important—with this faster process that uses less power, *one tank delivered more work than two tanks with the ordinary solution!* In short,a big production advantage was gained with no increase in equipment, and with a power saving to boot.

MORE WAYS UNITED CHROMIUM HELPS TO SAVE ON COATING OF METALS

Heating coil economy

At one installation, a Unichrome Tantalum Heating Coil had already given 4 years of service when inspected—and was found still good as the day first installed. While initially costing more than lead such a coil pays for itself quickly by eliminating downtime.

More nickel output

One supplier operated a Unichrome Nickel Plating Bath alongside another type. Even though in a smaller tank, Unichrome Nickel produced more work—because it needed less time out for purification treatment. (It now occupies *both* tanks.)

Nickel polishing slashed

So smooth were the deposits obtained with Unichrome Pyrophosphate Copper Plating that one automotive supplier was able to eliminate almost all polishing of the subsequent nickel plate—thus saving the time of six buffers for other work.

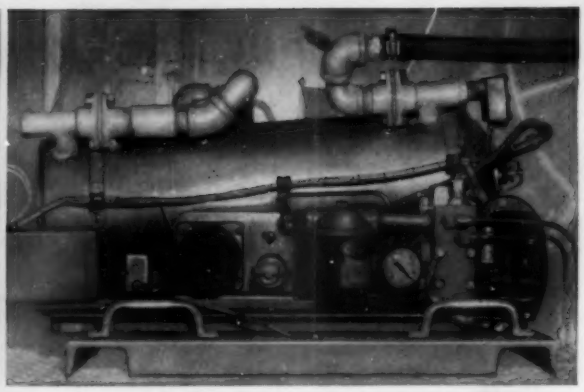
UNICHROME
Trade Mark

UNITED CHROMIUM, INCORPORATED
100 East 42nd St., New York 17, N. Y.

To finish it better and SAVE call in "The Unichrome Man"

United Chromium offers you the advantages of: (1) 25 years of specialized experience in metal finishing; (2) Wide experience in both organic and plated finishes; (3) A diversified line of products for decorative and functional finishing—including plating processes and equipment, protective coatings, chemical conversion coatings for zinc; (4) Thinking geared to cost-cutting, product-improving possibilities.
We'd welcome an opportunity to help you "Finish it better AND SAVE."

Waterbury 20, Conn. • Detroit 20, Mich. • Chicago 4, Ill. • Los Angeles 13, Calif. In Canada: United Chromium Limited, Toronto, Ont.



TYPE 0-6 CRASH TRUCK plus JANITROL LIQUID HEATER equals

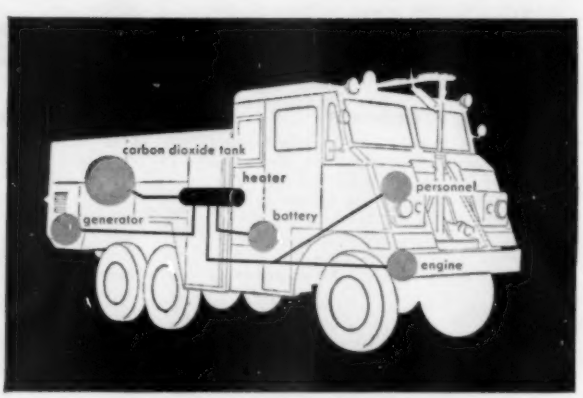
WINTERIZATION TO 65° BELOW ZERO

It takes just fifteen minutes for two men to install and connect, or disconnect and remove the Janitrol Liquid Heater equipped "winterization kit" in the Air Forces new Type 0-6 Cardox Crash Truck.

Cardox engineers took full advantage of Janitrol unit design accessibility . . . added a coolant pump, hand bypass pump, electrical over-ride connections, and an aluminum channel-iron skid base to come up with the ultimate in changeover speed. Just six quick-disconnect couplings tie coolant flow—electric supply—and fuel supply to the permanently installed winterization system within the truck. Operating controls are installed in the truck cab.

The Janitrol heater provides 90,000 Btu/hr for engine block, engine pan, battery box, radiator, cab and body, defrosting, a motor generator set, and the Cardox pressure vessel heating. Complete insurance against winter operating failures caused by freeze-ups!

Look into Janitrol Liquid Heater's long record of dependability under all conditions—and you'll specify "Janitrol" for vehicle heat wherever and whenever needed.



HEAT WHEREVER YOU WANT IT

Janitrol

AIRCRAFT-AUTOMOTIVE DIVISION, SURFACE COMBUSTION CORP., COLUMBUS 16, OHIO

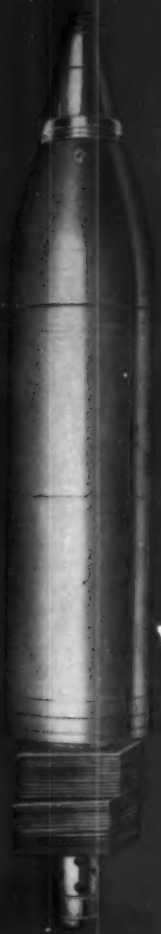
DISTRICT ENGINEERING OFFICES: NEW YORK, 225 BROADWAY; WASHINGTON, D. C., 4650 EAST-WEST HIGHWAY; KANSAS CITY, 2201 GRAND AVE.; FORT WORTH, 2509 BERRY ST.; HOLLYWOOD, CALIF., 7046 HOLLYWOOD BLVD.; COLUMBUS, OHIO, 400 DUBLIN AVE.

A MAJOR ORDNANCE DEVELOPMENT FOR THE DEFENSE OF OUR NATION

The coordinated efforts of KWIKSET DEFENSE PRODUCTS and Army Ordnance technicians have resulted in the design and manufacture of an improved 4.2" illuminating mortar shell.

Now, more than ever, the familiar call—FOUR DEUCE!—can bring immediate aid to our fighting men in the form of truly effective battlefield illumination.

The production and development specialists of KWIKSET DEFENSE PRODUCTS are proud of their latest contribution to America's military preparedness.



KWIKSET DEFENSE PRODUCTS

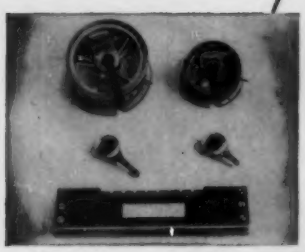
Anaheim, California

A Division of Kwikset Locks, Inc.

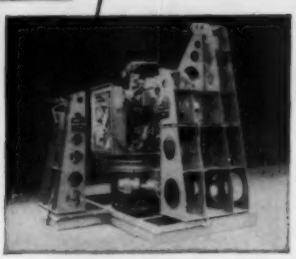
from
DRAWING BOARD
to
FINISHED PRODUCT
under one roof!

SERVO ANALYSIS NETWORK

ANGULAR POSITION TRANSMITTER



POTENTIOMETERS —precision linear and non-linear



GUN DIRECTOR—being optically aligned.

Serving the Armed Forces and Industry in the research, development, design and manufacture of electronic, electrical, electromechanical and mechanical devices—DAYSTROM INSTRUMENT has a full range of up-to-date equipment for production from raw materials to finished assemblies and systems. *Under one roof* their 350,000 sq. ft. plant has facilities available to meet every need for internal, external, surface and centerless grinding; low to high precision turning; jig boring and milling; welding, heat treating and finishing; spur and helical gear shaping; hobbing and shaving; straight and spiral bevel gearing; test and inspection, facilities and know-how for the entire range of production.

Division of Daystrom, Incorporated

DAYSTROM INSTRUMENT

ARCHBALD, PENNSYLVANIA

AFFILIATES:
American Type Founders, Elizabeth, N. J.
Daystrom Furniture Div., Olean, N.Y.
Daystrom Electric Corporation Poughkeepsie, N.Y.

Cork-and-Rubber Gasket Materials

Armstrong manufactures cork-and-rubber gasket materials made to meet each class of the principal government specifications covering cork-and-rubber gasket materials.

Specification	Material
MIL-G-6183	
Type I Soft	NC-709
Type I Medium	NC-710
Type I Firm	NC-711
MIL-T-6841	(DK-153 (RK-304S
Type II Soft	DC-167
Type II Medium	DC-100
Type II Firm	DC-113
MIL-G-6747	DK-149

Write for samples and 24-page gasket design manual.

ARMSTRONG CORK COMPANY
2905 Arch St., Lancaster, Pennsylvania

Fuller Gun Brushes On Active Duty

We are proud to be serving our Armed Forces with gun brushes. These brushes usually are available for an extra tour of duty because of their unique Fullergript construction. In this construction a tripled mass of brush material is loop-anchored inside a rigid metal backbone to provide a far denser brushing surface and extra long brush life.

INDUSTRIAL Fuller BRUSH CO. DIVISION

3585 MAIN STREET - HARTFORD 2, CONNECTICUT

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Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
MIL-10578 (Formerly U.S.A. 3-213)	
Type I (Wash-off)	Parco Cleaner 250
Type II (Wipe-off)	Parco Cleaner 260
MIL-C-5541 (Formerly AN-C-170)	Bonderite 710 (chemical film for aluminum and its alloys)
MIL-C-12968 (ORD) (Supersedes in part U.S.A 57-0-2)	
Type A—(Formerly U.S.A. 57-0-2, Type I, Class A & A1)	Parco Powder, Parco Lubrite 1 & 2
Type B	
Class 1 (Formerly U. S. A. 57-0-2, Type II, Class B	Parco Compound
Class 2	Parco Compound plus Endurion
MIL-C-16232 (BuORD)	
Type I	Parco Lubrite 1 & 2
Type II	Parco Compound
PA-PD-191	
Grade I	Bonderite 32, 34, 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
U.S.A. 72-53	Bonderite 32, 34, 100, 160, 170, 180
U.S.A. 57-0-2 [See also MIL-C-12968 (ORD)]	
Type II	
Class A & A1	Parco Lubrite 1 & 2
Class B	Parco Powder—Parco Compound
Class C	Bonderite 100, 160, 170 180

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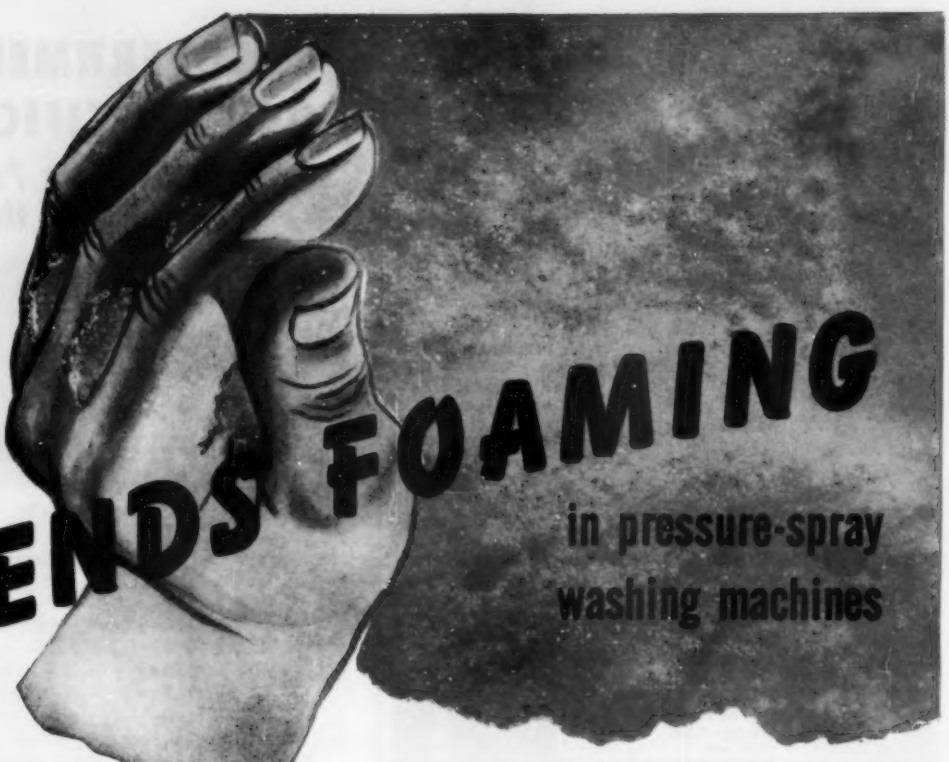

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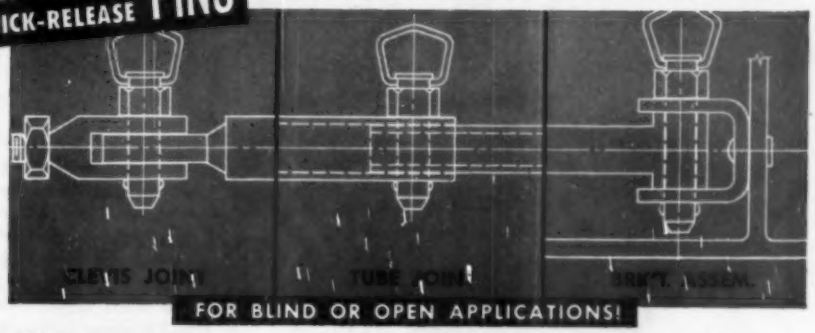

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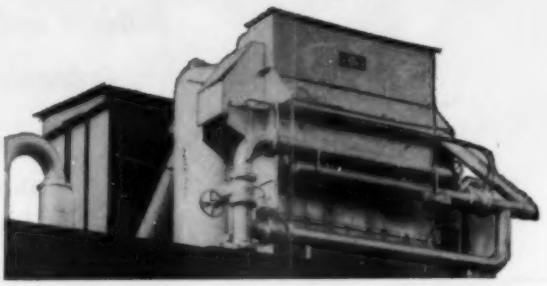

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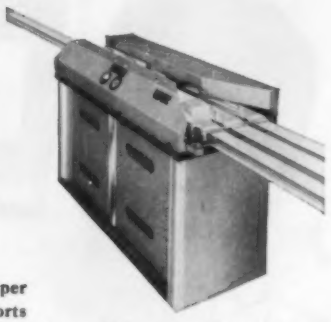

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ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

Hot Forging Shells

The "pierce and draw" method of producing artillery projectiles

Walter N. Howley

President, Lansdowne Steel & Iron Company, Morton, Pa.

IN 1940 the Lansdowne Steel & Iron Company was selected by the Ordnance Department of the Army to design, equip, and operate a plant which at that time was to be the largest shell plant in the world. At Gadsden, Ala., in the southeastern section of the United States, a site was selected and there the Gadsden Ordnance Plant was constructed.

The selection of this site was made by the Army Ordnance Department after considering many factors, such as decentralization, land availability, labor, power, raw-material supply, etc.

Taking into consideration the above, we find that such desirable locations are usually deficient in skilled mechanics and technicians. The steel supply, although available in quantity, might be of lower quality because the raw materials used in steel making might contain certain undesirable elements (Southeastern United States—high phosphorus). Regardless of location, the undesirable elements in iron ore and scrap must always be considered in selecting a manufacturing method.

In 1940 the complete cold extrusion of large high-explosive shells from bars was unknown in this country; however, cold forming (nosing) of hot pierced and drawn forgings was being developed as well as the complete cold forming of cartridge cases and mortar shells from steel disks.

Mortar shells were also made very successfully by the Murray Manufacturing Company of Brooklyn by forming a flat rolled product and welding two halves together. The "upsetter" method was being used by some manufacturers for hot forging smaller shells, and many people thought this method could be developed to advantage over the "pierce and draw" for small and large shells.

WE had many years of experience in the "pierce and draw" method and were also familiar with "upsetters," dating back to the old "bulldozer" method and the European type originated in Austria; consequently we understood their limitations and their advantages.

After careful consideration we decided to install the hot pierce and draw method at Gadsden. This decision proved to be correct. It was determined later in World War II that the upsetter method was less desirable for shell forging than pierce and draw, and new installations since then have confirmed this conclusion.

It is also of interest to recall that because of the shortage of steel of the quality necessary to produce cold-

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CRITERIA	METHODS OF MANUFACTURE OF 105-MM. SHELLS			
	1940		1954	
	Hot Pierce and Draw	*Hot Upsetter*	*Hot Pierce and Draw*	*Cold Extrusion*
1. Is the method proved over thousands of acceptable shells produced?	Yes	No	Yes	See remarks[1]
2. Does the method require skilled toolmakers and/or setup men?	No	Yes	No	Yes
3. Is this method capable of rapidly adjusting to changes in shell design?	Yes	No	Yes	No
4. Is the method capable of using the following steel mill products:				
Blooming mill products	Yes	No	Yes	No
Billet mill products	Yes	No	Yes	No
Bar mill products	Yes	Yes	Yes	No
Specially conditioned bars	Yes	Yes	Yes	No
Off-size bars	Yes	No	Yes	Yes
5. Does the method save any alloying elements?	No	No	No[2]	Yes
6. Does either method produce a satisfactory product?	Yes	Yes	Yes	Yes[3]
7. Can steel supply be stored outside?	Yes	Yes	Yes	No
8. Is the method metallurgically restrictive to the steel melter?	No	No	No	Yes[4]
9. Does the method appear to have a saving in capital equipment?	No	No	Yes	No
10. Can equipment be easily secured from many sources?	Yes	No	Yes	No[5]
11. Does either method appear to have a sizable				
a. Labor saving	No	No	No	No (see discussion)
b. Material saving	No	No	No	No (see discussion)

[1] Method has not been tested in all-out war. Korean emergency experience can be a guide as to what can be expected under all-out war conditions. The steel producers claimed they did not have available steel.

[2] There is a saving in manganese. For the 105-mm. shell, hot forge can use a minimum of .60 per cent, cold extrusion a minimum of .30 per cent; hot forge can reduce manganese consumption by water quench if the risk, probably comparable with physicals produced by cold-working, is warranted.

[3] Unless there are subsequent developments resulting from the effects of storage or temperature extremes.

[4] If physicals must be produced by cold-working chemical elements the melter must be restricted. The hot forge, quench and draw method can produce acceptable physicals within great chemical ranges by changes in heat-treating temperatures. This is the reason why a great number of heats, undesirable for other purposes, can be directed to hot shell production with complete safety and economy. Hot shell producers can use scrap contaminated wtih residual or tramp alloys, in many cases to advantage, whereas if the physicals must be produced by cold-working they result in hardships and dangers.

[5] Experience has shown that cold extrusion requires much greater capital investment in equipment. This type of equipment, difficult to secure during emergencies, should be used for items where it is peculiarly adaptable and where the production savings are so great that the hot method could not be considered. This is not true of the 105-mm. and similar shells.

Criteria used in evaluating methods of 105-mm. shell manufacture in 1940 and 1954.

formed cartridge cases from disks, Gadsden had started an installation to produce cases. The method to be used was to hot forge cups, true-up and peel the forging, and then cold draw into cartridge cases.

There was some consideration given by us to hot pierce and cold draw from bars without turning, but this was decided against because of the apparent steel difficulties and expense necessary to hold concentricity in production without turning.

To make sound decisions as to methods of manufacture certain criteria must be used to accept or reject processes and techniques, and the criteria used in the selection of the pierce and draw method are listed on page 322 under the "1940" column.

WE did not consider methods of nosing, heat treating, or machining among the criteria since they would be almost identical regardless of the forging method selected. The criteria were not weighted for their relative importance; however, the advantages and disadvantages are obvious.

Our prospective estimates indicated that the pierce and draw method would be the most reasonable to the Government; however, this was not our foremost consideration. Our prime consideration was to select a method which would assure continual and acceptable production in time of war and would be capable of being expanded with the assurance of quick and satisfactory production. This requirement had a very important effect upon our decision to use the hot pierce and draw method.

Six men were taken from our Morton plant for the entire job which included designing the forging equipment (including presses) as well as designing many machine tools.

Our production started on time, and at Gadsden we produced 105-mm. shells at a rate as high as 750,000 a month at a lower price than any other producer in the country ($2.38 each, including our fee, for a finished 105-mm. shell at the economic level prevailing in 1945, this price including steel, bands, boxing, etc., and all private and Government clerical help and expense, excepting four Army officers who supervised inspection).

This record might well be used as the basis for evaluating other methods until by comparison it is found wanting.

"The underlying philosophy of the Shell Committee is that industry must consider the future not only as requiring production for peacetime needs but also for wartime demands. It is our hope that managers of plants making similar products to those used by the Ordnance Department will consider it good business to accept this dual responsibility.

"While we are following the methods that must be used if any emergency arose in the next few years, new methods are not being overlooked, nor do we overlook the tremendous responsibility that rests upon the individual Army officers who make determinations regarding the products that show great promise but require great gambles. Cold extrusion of shells is a good example. This cold extrusion could change our thinking regarding shell making, but it presents tremendous risks and it requires great development.

"The hot forge manufacturers and the cold extruding manufacturers are approaching this matter on a most enlightened basis. Neither of them know what should be done. We hope to perfect both methods if possible and make it easier for an important decision to be made by the individuals in the Ordnance Departments. It will take a long time before any intelligent decision can be made. There are many angles to be considered."
—WALTER N. HOWLEY, *Chairman, Shell Committee, American Ordnance Association, at Industrial Orientation Conference, Washington, D. C., February 15, 1950.*

It is now almost fifteen years since we started Gadsden and almost ten years since the last shell came off those lines. Since then our country has gone through the Korean emergency and is now partially mobilized for war production. In the event of all-out war, Army Ordnance and industry will again be faced with decisions as to methods and locations of shell production.

Let us now analyze the Gadsden methods of producing shells as these apply to any part of the country or the world, with few exceptions, and decide what is necessary to bring the 1945 Gadsden figure to the 1954 economic level. We should also examine what improvements in the art of hot forging have been or can be made.

Since 1940 a new method of shell manufacturing commonly known as "cold extrusion" has entered the picture. The passage of years, however, has not altered the criteria for manufacture, and it is unrealistic to analyze shell making under any condition other than mobilization during all-out war. Therefore our 1940 criteria should now be used to appraise the relative merits of this new method of manufacture. The 105-mm. shell is such a heavy user of steel and is required in such large quantities that it is still an excellent shell to use for comparison. (See list on page 322 under the "1954" columns.)

Regarding material savings, the basic axiom that "matter can neither be created nor destroyed" is quite appropriate in this comparison.

Regardless of the number of pounds of bar or billet steel required to produce a finished shell, the only steel ultimately lost to our economy is that which comprises the finished shell and which is therefore expendible.

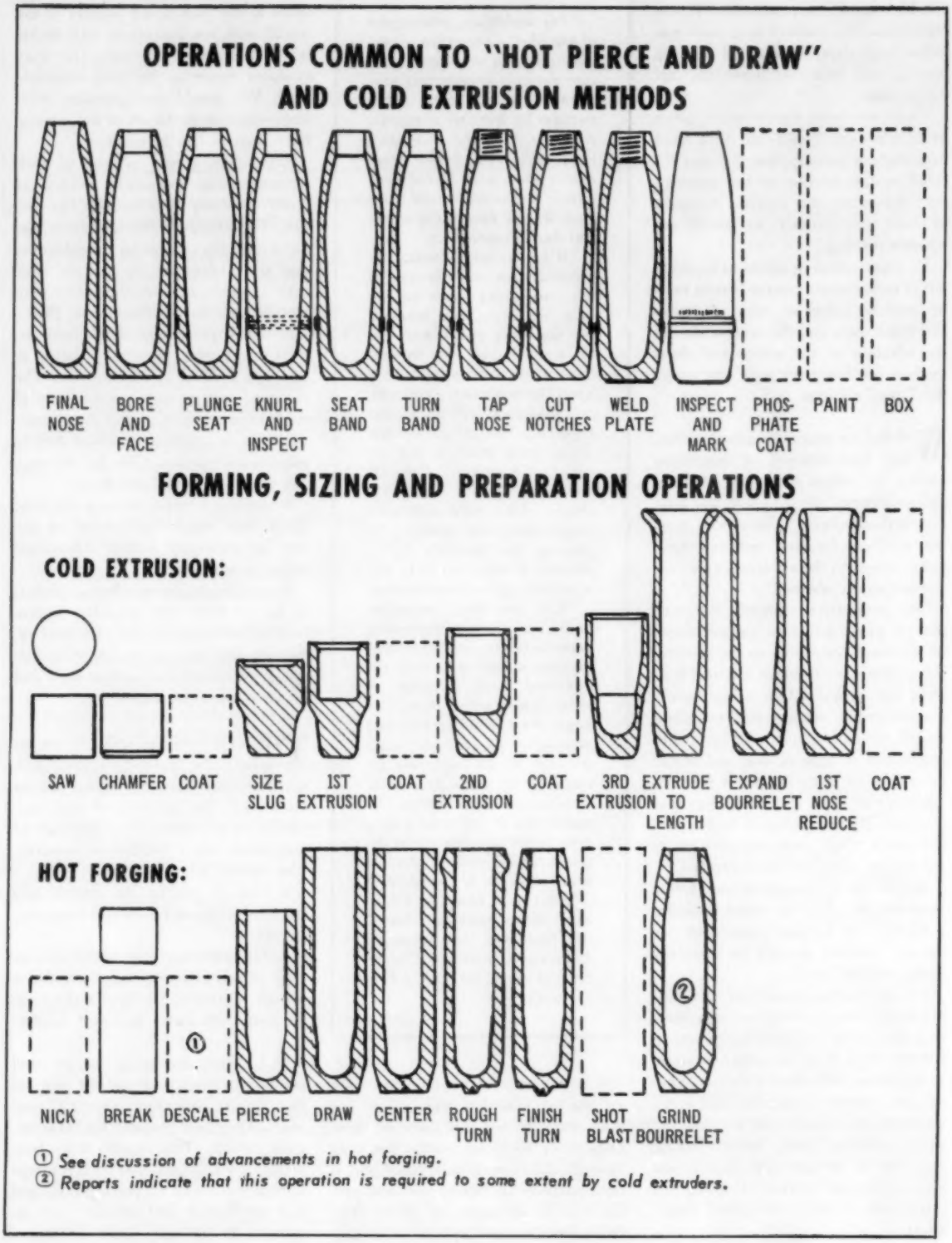
THE scrap turnings, scale, etc. are recycled to the steel mill, remelted and, therefore, this "matter" is not lost or consumed. The question of steel consumption, therefore, is a question of economics, not a question of material. The factors are:

1. Cost of peeling the outside and transportation costs to recycle scrap, etc., to mills.

2. Inspection methods used at a forge plant which give more assurance that a greater portion of the steel melted can be used with safety for shell production.

Our rejections using single and double converted steel for the past six years have been approximately one-twentieth of one per cent for metallurgical defects. This would have been greater if we did not have the advantage of nick and break for parting slugs and making interior and exterior steel inspection at an early point in manufacture; also rough turning for eliminating outside defects.

If either of the above points caused



Comparison of hot-forging and cold-extrusion methods for manufacturing 105-mm. high-explosive shell.

excessive effort or cost due to being carried out at the forging plant, a very noticeable difference in the cost of cold-extruding compared with hot forging would be evident. This is not the case and has confirmed what those of us in the trade knew—that scrap value more than offsets the mill inspection costs and transportation of scrap back to the mill.

3. The remaining consideration is the relative consumption of our steel melting facilities. The best basis to express steel consumption is in pounds of ingot steel required per finished shell. Analyses made by others have compared the weight of rough hot forgings with the weight of cold-extruded shell.

THIS comparison has been erroneous since it assumed that it required no more effort or pounds of ingot steel to produce a pound of steel ready for cold extrusion than is required to produce a pound of forging-quality steel.

In a cold-extruded shell the exterior of the shell was originally the exterior of a rolled bar and the exterior of a rolled bar was originally the surface—or from a few mills, very close to the surface—of the cast ingot.

This surface is inherently imperfect for many reasons and contains more seams and nonmetallic inclusions than steel below the surface. This rudimentary principle of steel making has been known for generations and, therefore, many high-strength products are manufactured from peeled bars.

The outside diameter of a hot shell forging is in part determined by the requirements we care to place upon the steel producer. The dangerous and unpredictable surface of the steel is turned off by us because the cost of inspecting and removing these imperfections at the mill is less reliable and more costly than removing the entire surface at our plant by the rough- and finish-turning operations.

In a cold-extruded shell, however, the burden of inspection and elimination of these surface defects is left entirely with the steel mills which are not equipped to do such work. It is difficult, if not impossible, visibly to detect and remove all surface seams in steel bars even when costly operations are used, and therefore the responsibility placed on the steel mills is grave indeed.

The difficulty experienced by mills who have rolled steel for cold extrusion bears out the above statement. The conditioning of the surface of cold-extruded bars is a herculean task, and even with the best efforts of the mills the rejection due to surface and other conditions has been, and will continue to be, an appreciable factor.

THESE rejections and the rigid size and chemical requirements have reduced the yield from ingots of all the steel cast for cold extrusion below the yield for hot forging steel.

This reduction in yield is such that a comparison of the 105-mm. hot-forged slug weight of 36 to 38 pounds (Gadsden Ordnance Plant, 1940 to 1945) with the reported 27-pound slug weight for a cold-extruded shell will reveal that there will be practically the same amount of steel cast to produce a shell by either method.

The yield from the ingot for either process might vary from mill to mill, depending upon individual mill practices. However, cold extrusion will require as much ore removed from the ground and as much, if not more, of our steel-making facilities as the hot-forging method. In addition, the ore and scrap required for cold-extruded steel is of more restricted quality, and the suppliers of this grade steel will be very limited.

To produce 105-mm. shell by hot forging, there are approximately twenty-three production operations required (with the exception of heating and heat treating which are to be compared later). To produce a shell by cold extrusion, approximately twenty-six production operations are required. Of these comparative operations approximately thirteen are common to both methods.

THESE common operations include the proper and expensive inspection operations which many people are inclined to overlook, and operations such as band seat turning, seating band, band turning, threading, etc., which are the most exacting and difficult machining operations (see chart on page 324).

The comparison is, therefore, narrowed to the point that to eliminate nine or ten hot-forging operations approximately 13 cold-extrusion operations are used.

It is obvious, therefore, that there is not an elimination of operations by cold extrusion but a replacement by other means which will change from time to time—but the hot operations logically should be fewer. An analysis of these operations shows that the labor differential will be negligible.

In the foregoing paragraph we excluded heating so that it could be analyzed separately.

The working of steel without putting heat into the piece creates stresses which require some means of relief before subsequent operations can or should be performed since these stresses are known to be dangerous. Therefore, the cold extruder must use heat as a stress reliever, whereas the hot forger uses heat for ease of flow with minimum of stresses.

To cold-work low-carbon steels to the physical properties required in high-explosive shells a practice is followed that requires the shell to be heated to a total, in different operations, of approximately 3,600 to 7,000 degrees Fahrenheit, depending on the chemistry of the steel.

To hot-forge a shell, allow it to cool, reheat for quenching and draw requires, for all operations, approximately 4,650 degrees Fahrenheit, if we use the 1940 methods of manufacture.

A comparison of the capital and operating cost of heating for the two methods, after considering the above requirements, will be found to be very illuminating.

OUR analyses of the basic criteria for wartime production again bring us to the conclusion that the safest and only method we know of that will assure large quantities of most high-explosive shells is hot forging—unless tremendous captital investments are to be made at the steel plants.

No other method will produce such shells at as low a price to the Government if proper consideration is given to planning the hot process.

We have used cold extrusion for the purpose of comparison. The hot-cold method which has the objective of eliminating the rough turning or peeling operation presents additional problems compared with the cold method, such as sacrificing working with cold tools and adding troublesome heating methods (salt baths, etc.), because it continues to be necessary to protect the surface.

There are advantages because of reduction in size of presses over the cold method and reduction of the stress dan-

gers, but if the cold-extrusion tally sheet is used and if appraisal of accomplishments is compared with the forecasts of some of the experienced shell manufacturers, it will not be difficult to appraise this method properly.

Our discussion and comparisons have not considered the advancements which have been made in hot-forging practice since 1945. Advancements to date in heating techniques have greatly affected not only forgings but also subsequent operations.

After investigation of a report made by our company to the Navy Bureau of Ordnance and a review of various manufacturing methods, the Bureau of Ordnance of the Navy decided to explore further the "Lansdowne" methods and views in connection with shell making.

Authorization was given to expand development work which had been started by Lansdowne Steel & Iron Company in connection with heat treatment, rapid gas heating for forging, and steel availability in coöperation with Selas Corporation of America and experienced steel-producing metallurgists.

At Gadsden we made the 105-mm. shell from slug weights of from thirty-six to thirty-eight pounds. The slugs were nicked and broken from products rolled on all types of mills and heated in box-type open-fired furnaces.

The slug weight could have been less if the following practices were used:

1. Throw a greater burden on the steel mills for conditioning bars than was economical.
2. Give up the nick and break which gives a simple foolproof method of inspection for internal and external defects. This operation affords the forger an opportunity to take immediate steps to correct mill practice. (This is most important during war.)
3. Recondition and replace draw rolls to save steel beyond the point of economy.

SINCE these advantages were too great to sacrifice for small material savings and since the conditions which would have to be placed on the steel mills were too severe, we directed our development efforts to subsequent operations, starting with heating.

As a result of developments with Selas Corporation of America, a rapid-heating gas furnace has been perfected and makes available to the shell manufacturer an accurate and reliable method of heating which has opened the door to innumerable advancements. In the past, forging practice has been restricted by large variations in the heated slug and the formation of heavy scale. With this new type of heating we have found it possible to:

1. Reduce the forging temperature from 2,100-2,200 degrees Fahrenheit to 1,800-1,850 degrees without requiring any different forging presses than were used at the former temperature.

2. Eliminate the descaling operation since the formation of scale in the rapid-heating furnace at these temperatures is negligible.

3. Increase tool life due to reduced temperatures and elimination of scale.

4. As a result of better control of forgings and negligible heat and scale losses, we could reduce slug weights appreciably. (On a 105-mm. M1 shell we would today use a 34½-pound slug compared with a 38-pound slug using conventional heating methods.)

IN addition to these obvious advantages, controlled heating has allowed us to develop with Selas other equipment which will revolutionize not only the forging but also the heat-treating of shells.

The advent of these new methods of hot forging in our opinion makes the advantages of this theory of manufacture more evident and reaffirms our position "still to hot forge shells."

The application of commercial practices and techniques to ordnance production is often of immeasurable assistance to the Army and the Navy. In many cases, however, commercial standards of acceptance and factors of safety are inadequate when one malfunction of an item of ordnance material can cause the loss of human life.

In addition, the Ordnance establishments of necessity must require high quality standards when all the industrial facilities of the country are taxed to the utmost and when know-how is stretched to the breaking point.

Knowing that these requirements and conditions exist, we must guard against the inadvertent use of commercial practices and techniques which might be wanting when used for ordnance material in all-out war.

A high-explosive shell is a good example of an ordnance item which *cannot* sacrifice quality for expediency and which is required in quantity at a time when quality is most difficult to secure.

THESE conditions make the following points pertinent and worthy of consideration when selecting methods of high-explosive shell manufacture:

1. The exacting requirements of a closed-chamber weapon in which high-explosive shells are used are not compatible with the less stringent requirements of mortar shells, rockets, and missiles. This should be realized in an appraisal of the methods of high-explosive shell manufacture.

2. No method of shell production should utilize practices or techniques which are considered questionable or dangerous for high-quality commercial products.

3. Inspection safeguards by hot forging are better than can be accomplished by any method that uses in the finished product the outside of a cast unpeeled ingot.

4. Sound business judgment dictates the installation of simple, convertible equipment for requirements that cannot be definitely known at this time.

5. The most versatile method of producing physical properties from the widest range of desirable and undesirable elements is by quenching and drawing at the desired temperatures, and high-explosive shell should be made from acceptable steel with wide chemistry ranges as long as it is capable of meeting minimum physical requirements.

6. Rough shells and rough-machined shells can be stored as easily in the open as steel from the bloomer or bar mills which means they can be shipped throughout the country in open cars. Therefore, continuous and uninterrupted production should not be a requirement for these shells until they have passed the first finishing operation.

7. Any wartime method of manufacture should endeavor to utilize small finishing plants located all over the country. Experienced hollow forgers working with their steel suppliers should produce a product that can be shipped to such finishers guaranteed as to soundness and physicals, thus vesting the responsibility of heat-treating and forming with these companies most experienced in this work.

Ordnance in the Field

The evolution of the Ordnance company, battalion, and regiment as elements of the division, corps, and army organization, from the meager beginnings in World War I – and the outlook for the future

Maj. Gen. J. K. Crain

General Crain, in addition to his oustanding service as an Ordnance officer in field operations, has a distinguished record as an arsenal commander and authority on artillery ammunition. He is now retired and resides in Washington, D. C.

"WHAT is past is prologue." This statement appears upon the front of the Archives Building in Washington. Accordingly, the following bits and pieces of the past are set down in the hope they will prove useful to the younger generation of Ordnance officers who will plan for the next great emergency.

I sailed for France in September 1917 with the advance party of the 42nd (Rainbow) Division of which I was the Ordnance Officer. When we landed only one American division, the First, was in France, and its organization had not been completed. A few months later the First Army Corps was organized and it fell to my lot to be appointed its Ordnance Officer.

The first step taken to organize an American field army was the designation of Lieut. Gen. (then Col.) John L. DeWitt as G-4 of the army. He and the nucleus of his future staff were attached to our corps headquarters, but he functioned directly under General Pershing's headquarters.

THE American Army was growing like Topsy. The divisions were widely dispersed in training areas and in the front line, and General DeWitt was constantly on the move inspecting the growing forces. I accompanied him on numerous occasions, and I also made as many trips alone as our limited transportation would permit.

At that time Ordnance personnel with the troops consisted of an Ordnance maintenance company for each division and a few enlisted men scattered among various line organizations. An infantry regiment, for example, was furnished a noncommissioned officer and three or four privates. These had no equipment or supplies. I found them doing kitchen police for the unit which fed them.

Later, as Ordnance Officer of the Second Army, I had these detachments concentrated at railheads, salvage dumps, and other points where under the direction of Ordnance officers they could perform useful Ordnance work.

The tables of organization showed the Ordnance maintenance company attached to the division ammunition train, and the colonel commanding the train assumed command of the Ordnance company. In one division I found that the Ordnance company personnel had been called upon to wash the ammunition train trucks because the ammunition train personnel were fatigued when they returned from a mission.

By reason of this and other occurrences I got our corps to issue instructions to all divisions that the train commander would exercise no command over the Ordnance company except when the division was on the march.

The status of the Ordnance company was still unsettled due to various causes. In most divisions the artillery brigade headquarters exercised more control over the company than did the division Ordnance Officer. The format of organization tables was partly responsible, but during this formative period personalities played a large part in determining who would do what.

SEVERAL lessons may be deduced from the foregoing condensation of many incidents the importance of which was due to the gravity of war:

1. The concentration of Ordnance forces increases ability to carry out the Ordnance mission.
2. The necessity for a chain of Ordnance command or technical supervision from top to bottom.
3. A unit or detachment which lacks housekeeping facilities is handicapped seriously in the performance of its functions. If a unit must obtain its meals from another organization it is shackled to that organization. This is all right in garrison, but it is entirely unsatisfactory under combat conditions.
4. Correct tables of organization should be in being when a mobilization is ordered.

During the St.-Mihiel battle I obtained agreement to the concentration of the Ordnance maintenance companies of three divisions in one location so that they could support one another; for the damage to equipment would vary among the divisions, and all three companies would repair damaged material without regard to the division from which it came.

This idea was not original with me. I picked it up on a week's visit to the headquarters of the French XI Corps in Rheims in February 1918.

This was the germ of an Ordnance maintenance battalion under the command of an Ordnance officer.

THE ammunition supply problem was even more confused. It was my thought that since the Ordnance Department designed and manufactured ammunition it should handle it in the field. But when I brought this subject up with our corps assistant chief of staff for operations, General Stuart Heintzelman, he took from his safe some secret tables of organization prepared at General Pershing's headquarters and pointed out to me that the Field Artillery was charged with this function.

The tables contained the specific notation that "the Ordnance Department would have nothing to do with the handling of ammunition in the field."

However, it appeared that the Field Artillery was limiting its organization to mobile ammunition trains, and that no units were planned to man the large network of field ammunition depots, as distinguished from trains, required for the army.

As General DeWitt was responsible for army supply I suggested to him that we initiate on a small scale an American ammunition depot and supply system for the training of our personnel. He agreed heartily, and I obtained permission from the French for the use of space adjacent to their army ammunition depot at Domgermain near Toul. This agreement was conditioned upon the Americans performing the work and bearing the expense of installing railroad tracks, etc.

I then prepared a letter to GHQ outlining our plan and requesting approval. General Hunter Liggett signed the letter and General DeWitt and myself drove to Chaumont to present the document in person.

To our amazement the staff reaction at headquarters was unfavorable, and after several hours of fruitless discussion the plan was disapproved. The clinching argument to support the disapproval was that it was not known what sector of the front would be occupied by the Americans, and therefore any money spent upon our project might be wasted!

Later in the year I became Ordnance Officer of the Second Army, our headquarters was in Toul, and I had charge of the ammunition depot at Domgermain.

After the war had ended I was in Tours and in conversation with Brig. Gen. J. H. Rice, Chief Ordnance Officer of the S.O.S., who mentioned that he had recently submitted an explanation for the failure of the Ordnance Department to prepare for the handling of ammunition in the field.

He was considerably chagrined when I informed him of the original decision of GHQ that the Ordnance Department would have nothing to do with that function.

After the disapproval of our effort to start a training program for ammunition supply and the consequent pointing up of the need for personnel for this task nothing happened at our corps headquarters until we moved into the St.-Mihiel sector. There a number of French artillery units were attached to our corps, and our corps artillery commander was General Vincent of the French Army.

I WAS then attached to General Vincent's staff to handle the supply of ammunition for the corps. My American staff comprised one artillery lieutenant (Lieutenant Falk, a Chicago lawyer), two sergeants, and two motorcycle messengers.

No corps ammunition train had been organized, but one was improvised by taking the division ammunition train of a replacement division and adding to this nucleus detachments gathered from various sources. Nor had any personnel been provided to man the corps ammunition depots. The army ammunition depots were all manned by the French, and the war was nearly over before American personnel began to take over the army depots.

We followed the French system of using corps ammunition depots in advance of the army depots so as to have ammunition close to the troops. In the first stages of the Argonne Forest fight, cannoneers of a 155-mm. howitzer battery loaded their pieces from stacks of shells in our corps depot at Varennes. This is probably the shortest line of supply known between a fieldpiece and a corps installation!

Incidentally, I had our staff order this unit away from that position lest German counterbattery fire destroy this very valuable corps ammunition depot.

Since there were no personnel set up for our corps depots I was compelled to take infantry companies from the nearest division for this purpose. Entire companies had to be taken in order to be self-sustaining; that is, to be able to feed themselves.

A COMPANY would march to the designated location, stack arms, and become "ordnance experts." The inefficiency of this procedure from both the supply and combat angles is obvious. It was apparent, then, that Ordnance ammunition companies must form a part of field armies in the next war.

As chance had it I became Assistant Chief of Ordnance in charge of Field Service in 1940 when preparations for a possible war were in full swing. This gave me the opportunity to utilize the experiences of World War I in reorganizing the Ordnance units required for service in a theater of operations.

My objectives when we embarked upon the reorganization of 1940-1942 are set forth in the diagram on page 329.

My principal assistant in this reorganization work was Brig. Gen. (then Capt.) Waldo E. Laidlaw. I furnished the plan and guidance and Laidlaw did the work. The Infantry division had been reorganized following extensive field tests in Texas, and an Ordnance detachment had been determined upon in lieu of the Ordnance company of the old division.

Our first objective then was the corps Ordnance maintenance battalion. We drew up a table for this which was approved by the General Staff, and we presented the Chief of Ordnance, Maj. Gen. C. M. Wesson, with a battalion flag to commemorate the birth of the first Ordnance unit larger than a company.

The establishment of this corps Ord-

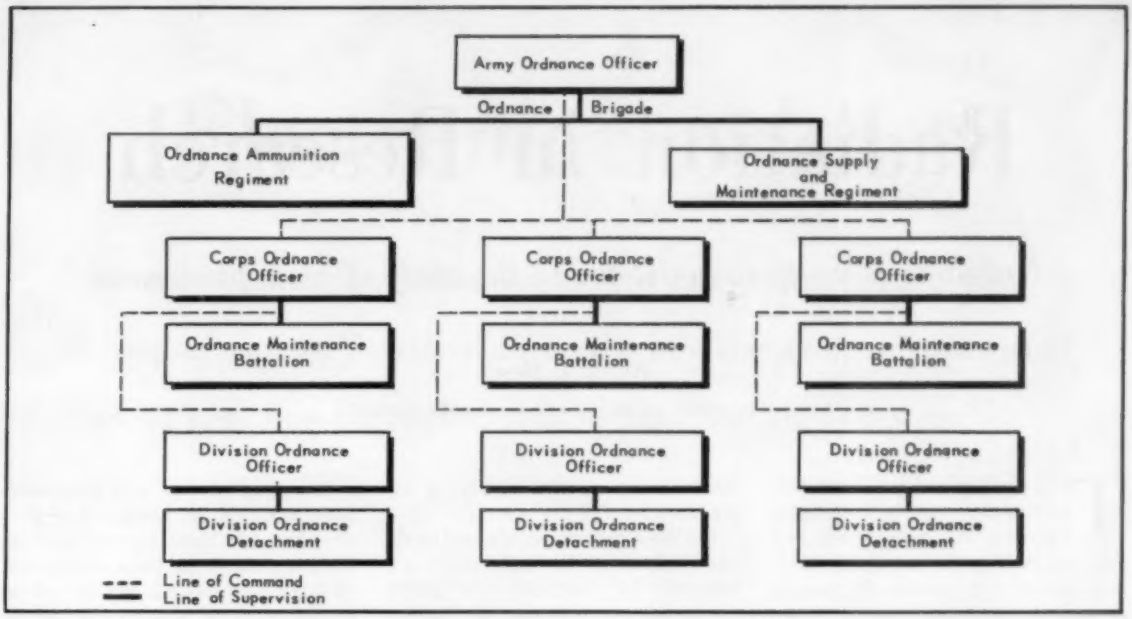


Diagram showing General Crain's plans for the reorganization of Ordnance units, 1940-1942.

nance battalion eliminated the chance of jurisdictional disputes over the control of Ordnance maintenance units such as had occurred in World War I.

However, we failed in our efforts to organize army Ordnance units into regiments and brigades. I still think the blocking of this part of our plan by a section of the General Staff was a mistake. Its approval would have given the Army Ordnance officers a closely knit military organization with which to execute the operational part of their functions. Further, it would have been economical of personnel, for a concentration of industrial effort increases its effectiveness just as a concentration of combat units increases their striking power.

IN the spring of 1941 Maj. Gen. Russell L. Maxwell, American commander in the Middle East, sent in a requisition for twenty-five hundred technicians to support the British in maintaining their American equipment, principally tanks.

Laidlaw and his assistant, Col. (then Capt.) Sylvester A. Hall, prepared a table for three Ordnance maintenance battalions which was submitted to the General Staff. It was disapproved by the Staff as the policy was to furnish no personnel to aid the British. It is interesting to note that at present (thirteen years later) we are furnishing technical personnel to assist the French in Indo-China.

Notwithstanding this disapproval we realized that, should the United States enter the war, Ordnance overseas base shops would be required. Accordingly, a new table of organization was prepared for this purpose, but it was drawn up as a regimental table. This was filed for possible future use.

In the early part of 1942 the General Staff called for recommendations for overseas base maintenance units. Our regimental table was taken from the files, submitted, and approved by the General Staff. This is the first Ordnance regimental organization ever approved. It consisted of three base maintenance battalions and one general supply and ammunition battalion.

Col. C. Wingate Reed, then chief of the Military Personnel Division of the Ordnance Office, secured the personnel for the first regiments mobilized through the aid of the National Automobile Dealers' Association.

I learned after the war that several of these base regiments had been sent overseas and had operated as regimental units until the end of the war with one major change. The general supply and ammunition battalion in each regiment was broken up. The depot companies of this battalion were assigned to the base maintenance battalions, and the ammunition companies were assigned to ammunition battalions.

Now the pendulum has swung, and there is an Ordnance maintenance battalion for each division.

However, the pendulum will continue to swing, and so in conclusion I offer these observations for consideration. New weapons will call for new dispositions, but the basic principles will remain.

The normal yardstick used in discussing the number of service personnel in a unit is the ratio of noncombat to combat personnel. There is another ratio of greater significance: the ratio of the volume of fire available when all weapons are serviceable and ammunition is ample, to the volume of fire available when these factors are reduced because of inadequate Ordnance service. Unfortunately this ratio cannot be determined.

Ordnance field units should be placed as near the front as is practicable.

Atomic weapons may force dispersal of units, and study should be given to the problem of effecting a concentration of Ordnance effort under such conditions.

And, finally, there should be an Ordnance chain of command and technical supervision from top to bottom.

Radiation in Research

Ordnance is using radioisotopes in the study of basic phenomena

Alfred J. Moses

Metals Research Branch, Watertown Arsenal Laboratory

THE study of many fundamental phenomena such as in erosion, corrosion, electrodeposition, and diffusion requires the use of very sensitive methods of pursuit. Radioactive isotopes—*i.e.*, radioactive species of the same chemical element—frequently provide the best such approach from the standpoint of sensitivity and cost.

However there are cases where the use of radioactive isotopes (hence called "radioisotopes") is not feasible due to the short half-life of the isotope in question. "Half-life" is the time required for the intensity of radiation to decay to one-half the initial intensity. In such cases, stable, nonradioactive isotopes are employed. The material is enriched in one of the stable isotopes, and measurements are taken by means of a mass spectrometer to detect changes in the isotopic ratio.

This information permits the establishment of the source origin of an element and its quantitative determination. This paper deals only with radioisotopes, hence stable isotopes will not be discussed any further at this time.

RADIOISOTOPES emit several types of particles and radiation. For tracer applications, the emission of negatively charged particles (beta particles and electrons), of positively charged particles (positive electrons or positrons), and of electromagnetic radiation (X- and gamma rays) are of primary importance.

This brief discussion does not go into the very useful and fascinating subject of analysis by activation with nuclear particles which is a method that allows the detection and often the quantitative determination of trace amounts of impurities.

The three most commonly used methods of detection for radioactivity are based on: (1) ionization of a gas by the particles or radiation, (2) blackening of photographic film by particles or radiation, (3) scintillations of light, produced by the impact of particles or radiation on certain materials.

GASEOUS atoms are split into oppositely charged particles by interaction with radiation. Where the gas consists of a single atom, such as with argon or helium, an ion pair is created consisting of a negatively charged electron together with a positively charged argon or helium ion.

In an ion chamber these ions are collected by two electrically charged plates. This movement of ions produces an electrical current which can be amplified and measured.

The proportional counter bears similarity with the ion chamber, but here the potential between the electrodes is increased until gas amplification takes place. The output pulse is a measure of the energy of the incident radiation, and the rate of these pulses is also a measure of the intensity of the incident radiation.

A further increase in potential brings us to the Geiger region. Here the formation of an ion pair sets off an avalanche of ions in the counter tube, now called Geiger-Müller tube. The output in the Geiger region is independent of the energy of the incident particle, provided its energy is sufficient to penetrate the counter window and cause the ionization of the gas.

A nuclear particle and electromagnetic radiation on passage through a silver-bromide-containing emulsion can make a grain of the latter developable. This is the principle of the photographic-emulsion technique for the detection of nuclear particles and radiations.

When a nuclear particle or radiation impinges on certain materials, such as anthracene or activated sodium iodide, these materials fluoresce. The pulses of light thus emitted are received by the photosensitive cathode of a photomultiplier tube and amplified electronically.

THE pulse height is proportional to the energy that is incident so that this type of detector acts as a type of proportional counter. The use of an appropriate linear amplifier, a pulse-height analyzer, and the ratemeter permits the determination of the distribution in energy of a particular radiation.

Of the types of apparatus described, the Geiger-Müller counter is beyond doubt the most commonly used counting equipment. Inefficiency for electromagnetic radiation as well as for low-energy electrons are its most serious handicap.

Photographic emulsions, when coupled with microscopic techniques, can give interesting information pertaining to the grain structure of metals and alloys; however, the proper use of this technique requires considerable specialization and training.

Scintillation counting is finding increasing use in the radiochemistry laboratory, particularly for counting low-energy electrons and electromagnetic radiations.

Electronic Analyzer

New device enables gasoline engines in our military equipment to be checked and malfunctions discovered and corrected, in many cases without removing the engine, making maintenance faster and easier

James W. Wheeler

IN his reflections on his battle experience during World War II, Gen. George S. Patton, Jr., had this to say about maintenance and mechanics:

"The Americans . . . are the foremost mechanics in the world. We must fight the war by machines on the ground and in the air to the maximum of our ability, particularly in view of the fact that the two races left which we may have to fight are both poor mechanics but have ample manpower."

To use our mechanical ability to its fullest advantage we must develop the best possible maintenance procedures. The United States Army, and in particular the Ordnance Corps, is constantly striving to improve the quality of maintenance.

Operators of machines traditionally give high priority to maintenance. To industry it contributes to lower operating costs; to the Army it can mean the difference between a battle won or lost.

BY educating its personnel, from privates to the field commanders, in the importance of preventive maintenance and by designing equipment with maintenance in mind, the Army has made great strides in this field.

The improvement of maintenance is a continuing process, however, and is constantly being studied by various agencies of Army Ordnance. The Maintenance Operations Procedure Shop at Raritan Arsenal, the Ordnance Tank-Automotive Center, and Detroit Arsenal, to name a few, work out new procedures and improved vehicle designs which facilitate maintenance in the field and in depots.

Mr. Wheeler is head of the Engineering Department for Engine Instruments, Sperry Gyroscope Company, Great Neck, N. Y.

Several agencies, such as the Ordnance Board and the Ordnance Corps Tool and Equipment Committee at Rossford Ordnance Depot, devote time to the testing and evaluation of new maintenance tools and equipment.

Before a new procedure or item is adopted it is usually tested at a proving site, such as Aberdeen Proving Ground, and then gets a "user" reaction from one of the Army Field Forces boards. Through the efforts of this "team" the U. S. Army not only has developed the finest maintenance of any army in the world but is held up as a model to civilian industry.

With the increased complexity of modern fighting equipment, new and sometimes radically different approaches must be made to the perennial problem of maintenance. Consequently the Army is currently evaluating electronic types of engine test equipment. One such piece of equipment is the engine analyzer.

To those familiar with aviation maintenance, engine analyzers are not new. The need for an accurate, easy-to-use maintenance tool to check out ignition systems and valve action brought about the development of the analyzer.

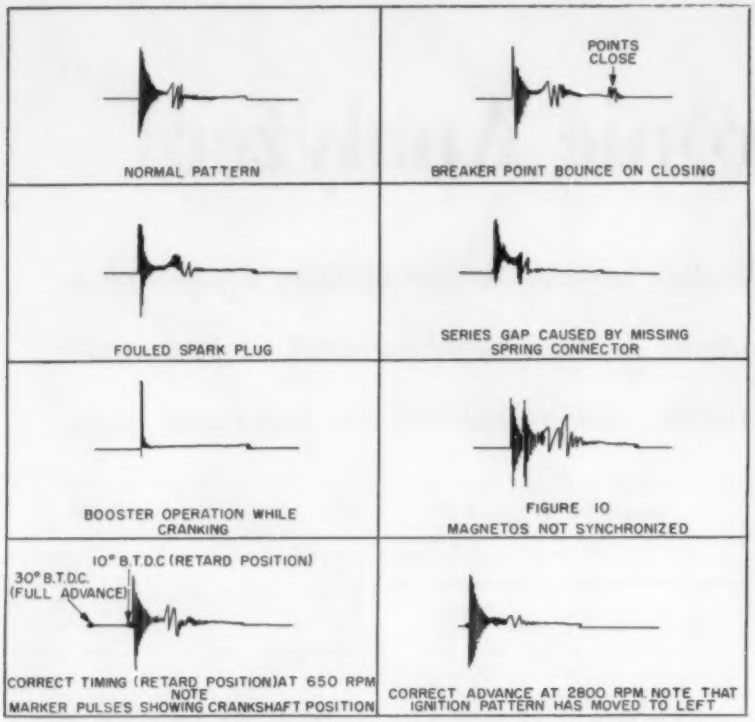
The value of reliable trouble-shooting equipment to aircraft users is apparent when one considers that the loss of revenue caused by grounding of a large ship can range as high as $37,000 a day. To the military, large users of analyzers, it can mean the difference between a successful mission and a failure —between an airplane returning to its base or lost to the enemy.

AIRLINE users have indicated that the cost of analyzers and engine harnesses are amortized in less than six months. The reduction in needless parts replacement alone, resulting from elimination of trial-and-error maintenance, pays for the engine harness in little over one year with the savings from parts cost only.

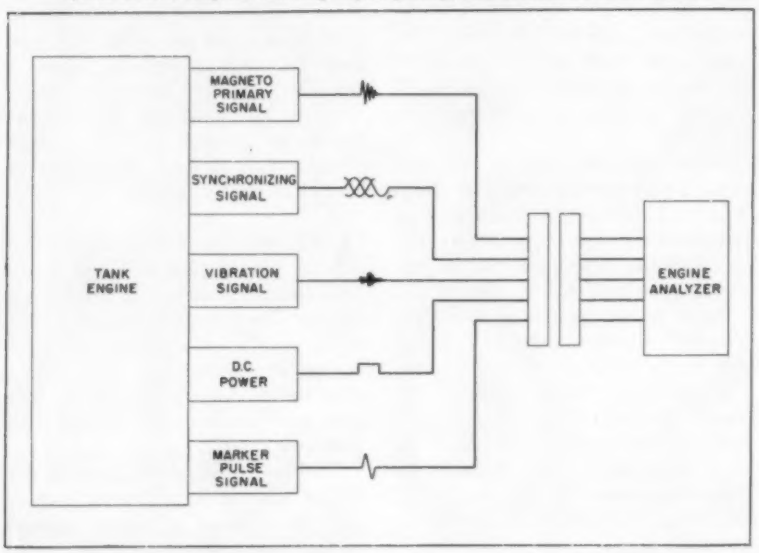
The two principal functions of the engine analyzer are: (1) the location and identification of engine ignition system malfunctions such as fouled plugs faulty magnetos, and incorrect timing, and (2) the location and identification of combustion or mechanical malfunctions such as detonation, incorrect valve clearances, and valve bounce.

To understand how ignition faults are revealed, the operation of a typical ignition system should be examined.

Considering first the magneto, it can be stated that at the instant the mag-


POINTS CLOSE
NORMAL PATTERN
BREAKER POINT BOUNCE ON CLOSING
FOULED SPARK PLUG
SERIES GAP CAUSED BY MISSING SPRING CONNECTOR
BOOSTER OPERATION WHILE CRANKING
FIGURE 10
MAGNETOS NOT SYNCHRONIZED
10° B.T.D.C (RETARD POSITION)
30° B.T.D.C. (FULL ADVANCE)
CORRECT TIMING (RETARD POSITION)AT 650 RPM NOTE MARKER PULSES SHOWING CRANKSHAFT POSITION
CORRECT ADVANCE AT 2800 RPM NOTE THAT IGNITION PATTERN HAS MOVED TO LEFT

Above, normal and abnormal vibration patterns recorded by the engine analyzer. Below, diagram showing engine pickups and connection to analyzer.



neto breaker points are opened by the engine-driven magneto cam mechanism, a high value of magnetic flux has been built up in the iron core structure of the magneto by the action of the magneto's permanent magnet rotor.

Then, as the breaker points separate, this magnetic field suddenly collapses, generating a very high voltage in the secondary winding of the magneto, which is connected to the spark plugs through the distributor. This voltage fires the spark plugs.

The magneto primary voltage presents the most convenient and reliable source for indicating the condition of the ignition system. Ignition troubles such as opens, shorts, fouled plugs, bouncing points, etc., all affect primary voltage; hence by analyzing the primary voltage we can detect, locate, and identify ignition abnormalities.

In addition, the primary voltage is more accessible and less hazardous to personnel than other possible signal sources, such as secondary voltage.

LOCATION of the troubles with the engine analyzer is rapid because the engine condition (*i.e.* ignition difficulty, mechanical difficulty) suspected can be selected by the operator with one switch while with a second switch he can locate and examine the particular cylinders in which trouble is occurring.

The economic return of analyzers is greatest with the more complex and larger engines, particularly where time is an important factor, hence their application to aircraft. The new "family of engines" adopted by Ordnance is not only large and complex but, due to small silhouette requirements, are placed in a compartment scarcely larger than the engine itself.

Obviously time is an important factor under battle conditions. The conditions for large economic return present in aircraft are therefore also present in tank operations.

TO adapt the analyzer to tanks, it is most desirable to prewire the engine for analyzer use since this permits more rapid analysis, eliminates unnecessary engine removal, and enables magneto timing and advance mechanism checks. To adapt an engine the following pickups are required (see the chart at the left):

1. *Power.*—A source of vehicle electrical power (usually either 12 or 24 volts, D.C.).

2. *Magneto primary voltage.*—A source of ignition signals (usually obtained at the magneto booster connection).

3. *Vibration signal.*—A source of vibration signals produced by engine events such as valve closings, combustion etc. (usually obtained from pickup mounted on cylinder head).

4. *Synchronizing signal.*—A means of synchronizing the analyzer to engine speed (can be accomplished by a small generator driven by the tachometer drive).

5. *Marker pulse signal.*—A means of obtaining absolute crankshaft position

so that timing can be precisely accomplished (usually obtained from a pickup permanently mounted over the flywheel).

The signals from the above pickups are transmitted to the analyzer (below, right) where they are presented on a cathode-ray tube screen. The pattern on the screen can be interpreted simply by comparison with typical patterns obtained under known conditions. The illustration at the right shows the AV-1790-7 Continental engine with malfunctions indicated which can be identified by the analyzer.

THE top diagram on page 332 is illustrative of some typical patterns for various conditions. The malfunctions can be detected quite readily by comparing with the normal. Breaker-point bounce caused by a weak spring results in a pattern which shows multiple closing of points.

Fouled plugs are actually partial shorts in the secondary and are detected by a smaller build-up and faster decay of voltage. A series gap caused by a missing spring connector will be shown by a higher build-up of voltage and slower decay.

Since the sweep of the analyzer is automatically synchronized to the engine's speed, and marker pulses generated by a pickup on the flywheel give exact crankshaft positions, we can very easily utilize the analyzer to verify the timing and advance of the magnetos.

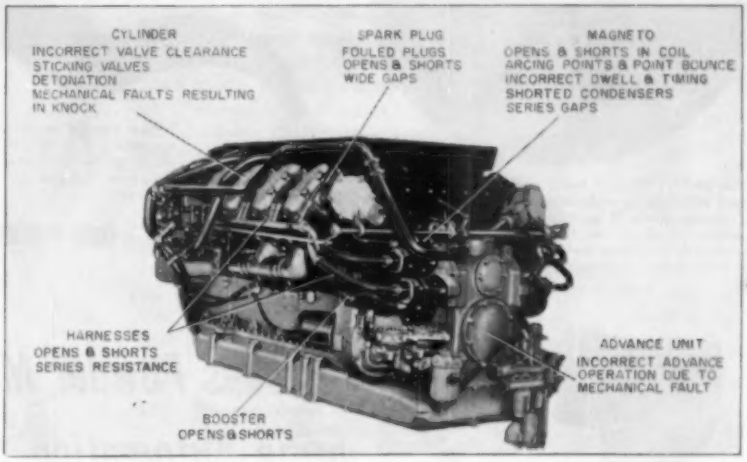
By merely manipulating one switch and observing the position of the patterns in relation to the marker pulses, the timing and operation of the advance mechanism can be verified in a matter of seconds. This method of ascertaining the timing of magnetos permits the setting of timing to within one degree crank angle.

The vibration pickups enable the observation of valve events much in the same manner as for ignition. Valve timing is verified similarly to magneto timing, and the valve action is analyzed by comparing with the normal. Sticking valves give intermittent patterns of smaller amplitude and apparent varying timing while a large clearance results in a large amplitude of signal and a distinct change in timing.

Lack of combustion, knocking, and detonation can also be detected through observation of the vibration patterns.

When one considers the methods now used to check magnetos, boosters, and spark plugs installed on tanks the value of the analyzer becomes more apparent. Static ignition timing checks are eliminated, and a precise adjustment can be made with the analyzer while the engine is running.

On an engine prewired for the analyzer a complete analysis, including boosters, magnetos, spark plugs, harnesses, valves, timing, and advance can be accomplished in less than five minutes. The elimination of trial-and-error maintenance and the pin-pointing of malfunctions decreases the frequency of engine removal.



Above, some typical faults illustrated in a Continental model AV-1790-7 engine which can be detected by the Sperry engine analyzer pictured below.

Gun part: A flanged bushing with internal splines. Time calculated to make by machining was two hours; by powder metal 30 seconds. The Stokes press actually delivers 10 per minute. It took only 6 weeks to start production in powder metal; 11 months was estimated to make broach for machining.

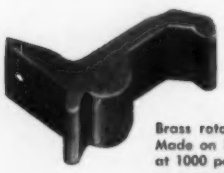
Knurled gun sight: Iron, manganese and graphite powders are used in making this part at a rate of 1200 per hour. Sintering converts the metals to alloy steel.

Trigger member requiring upwards of 20 operations if machined is made at a single stroke on Stokes Powder Metal presses at the rate of several hundred per hour.

Bofors gun part: This piece is virtually impossible to machine because of the blind-end grooves on the sides. It is made of powdered iron on Stokes presses at 1200 per hour.

Gun part of unusual contours is made at hundreds per hour on Stokes Powder Metal presses. The simplest machine techniques to produce the part would require 11 machining operations.

Fuse assembly: 18 separate operations of assembly and gaging on a Stokes Automatic Ordnance machine complete this piece at the rate of several thousand per hour.



Brass rotor for artillery shell booster: Made on Stokes powder metal presses at 1000 per hour, and savings of 70% as compared with cost by machining.

Stokes Powder Metal Presses bring Automation to the Making of many Ordnance Parts

Stokes fully automatic equipment serves Ordnance Plants in the following ways:

(1) Making metal parts automatically . . . of copper, iron, steel, brass and other alloy powders . . .

(2) Consolidating pellets and charges for many types of artillery . . .

(3) Assembling ordnance parts . . . often with as many as 18 separate but automatic operations on a single piece.

Typical metal parts automatically made at high speed are shown in adjacent illustrations with comparisons of what is required to machine them from solid metal.

Stokes automatic assembly machines combine automation with safety and a high degree of adaptability for changeover to varying requirements.

The experienced counsel of Stokes experts on Powder Metal and Automatic Ordnance Loading and Assembly equipment is available to you on request.

F. J. STOKES MACHINE COMPANY
ORDNANCE DIVISION, PHILADELPHIA 20, PA.

STOKES

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment

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SEPTEMBER-OCTOBER 1954

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ORDNANCE *is set up, printed, and bound for the American Ordnance Association by the William Byrd Press, Inc., Richmond, Va.*

Conquers Heat, Erosion and Corrosion. Stainless steels containing nickel lengthen life expectancy of various components used in severe service. For instance, Diesel engine turbocharger rotors. Some rotors operate at from 12,500 to 21,000 r.p.m., and at temperatures upward of 1000°F. The rotor comprises a slotted disc of chromium-nickel stainless steel, with inserted blades of the same material . . . to take the brunt of attack in converting heat into mechanical power. Type "19-9" stainless, containing molybdenum and tungsten additions, is used to make sure of high tensile strength and low creep at the high temperatures encountered. And a somewhat similar austenitic chromium-nickel stainless steel . . . 18-8-S-Mo . . . is used for turbine nozzle blades.

STAINLESS PROVIDES THE ANSWERS . . .

Thousands of designers and engineers have found austenitic chromium-nickel stainless steels to be the key to new high standards of product performance and minimum operating costs. You, too, may find that a stainless steel containing nickel will help solve *your* metal problem.

1. At Elevated Temperatures

Stainless steels of this type possess the two essential qualities for successful use at elevated temperatures. By virtue of the chromium content, and assisted by the nickel content, they have outstanding resistance to scaling and oxidation. The nickel content also results in high creep strength and stress-to-rupture properties. Combined, these properties permit use of chromium-nickel stainless even in thin sections required for lightweight design.

2. At Sub-Zero Temperatures

Experience has shown that unalloyed steels become embrittled rapidly as temperature is lowered below normal. Nickel is by far the best alloying element to prevent brittleness. At sub-zero temperatures, chromium-nickel stainless steels provide unsurpassed impact values. These steels retain such a high level of toughness that they are known to be useful at temperatures as low as −400°F. and possibly even lower.

3. Under Corrosive Conditions

Selection of exactly the right alloy for your specific needs may be made from some thirty alloy steels qualified to carry the family name "Stainless." By virtue of their strength and resistance to attack by chemicals and atmospheres over a wide range of concentrations and temperatures, these austenitic chromium-nickel steels assure not only longer life of the equipment and purity of product, but also permit decrease of bulk and deadweight without sacrificing safety.

4. Where Erosion Is A Problem

Chromium-nickel stainless offers the utmost in resistance to erosion and cavitation. By cold working, it is possible to increase the tensile strength to as much as 300,000 psi. When subjected to erosion, the erosive media work hardens the surface and, correspondingly, curbs the attack. This resistance to erosion combined with corrosion resistance results in prolonged life for equipment made from the chromium-nickel stainless steels.

5. Use *Stainless* To Meet Complex Requirements

Utilize the unique combination of properties provided by chromium-nickel stainless steels when designing new products or improving old ones. You can draw, spin, forge, weld, solder, punch, shear or bend chromium-nickel stainless steels. Leading steel companies produce these austenitic alloys in all commercial forms. A list of sources of supply will be furnished on request.

EMBLEM OF INCO SERVICE

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

New Cleveland high speed automatic gets increased precision from TIMKEN® bearings in semi-flexible mounting

DESIGNED to be the "work horse" of many shops, this 2½" Model AW automatic, built by the Cleveland Automatic Machine Company, Cincinnati, Ohio, is not only precise, it's versatile as well.

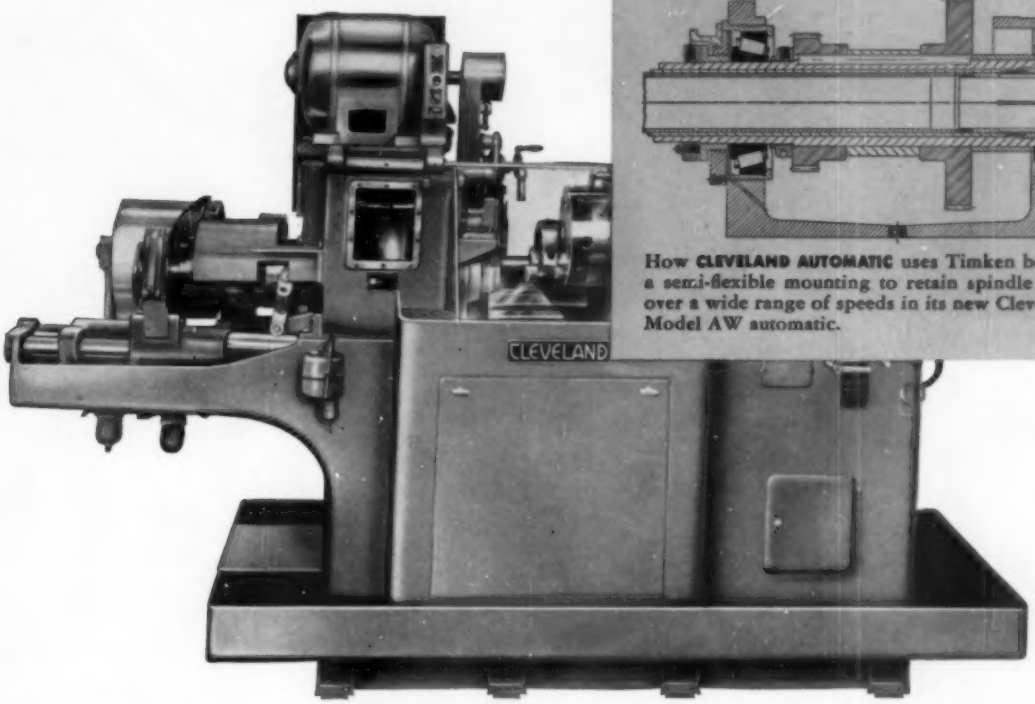
To accommodate its wide range of spindle speeds—40 in all—ranging from 69 to 1920 RPM, and to insure precision at any speed, Cleveland mounts the spindle on Timken® bearings in semi-flexible mounts. This permits any expansion during high speed operation without affecting accuracy.

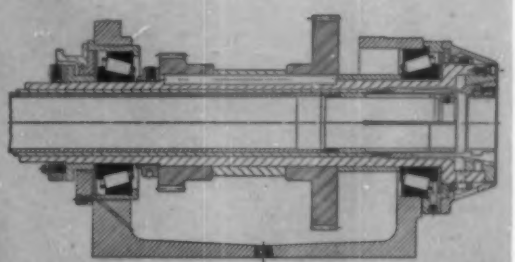
Timken tapered roller bearings hold shafts and spindles in rigid alignment. Line contact between rollers and races provides extra load-carrying capacity. Gears mesh smoothly with minimum wear under even the heaviest loads. Because of their tapered construction, Timken bearings carry radial and thrust loads in any combination.

The true rolling motion and incredibly smooth surface finish of Timken bearings practically eliminate friction. Shafts and housings are held concentric, making closures more effective.

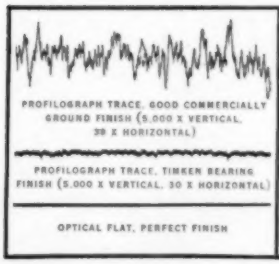
Be sure to specify Timken bearings when you build or buy machine tools. They normally last the life of the machine. Look for the trade-mark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.





How **CLEVELAND AUTOMATIC** uses Timken bearings in a semi-flexible mounting to retain spindle precision over a wide range of speeds in its new Cleveland 2½" Model AW automatic.


PROFILOGRAPH TRACE, GOOD COMMERCIALLY GROUND FINISH (5,000 X VERTICAL, 30 X HORIZONTAL)
PROFILOGRAPH TRACE, TIMKEN BEARING FINISH (5,000 X VERTICAL, 30 X HORIZONTAL)
OPTICAL FLAT, PERFECT FINISH

SMOOTH TO MILLIONTHS OF AN INCH

Surface finish of high quality Timken bearing rollers and races is so smooth that it takes a profilograph to measure its smoothness. This instrument measures surface variations to a millionth of an inch, as shown at the left.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

"four-pound pilot"

A four-pound proven, rugged and reliable gyro—laboratory accuracy on a production basis—is the key to the Arma Inertial Navigation System. This completely self-contained guidance system will be another significant contribution by Arma to pilotless aircraft and missiles operating in the tactical range. Arma Corporation, Brooklyn, N. Y.; Garden City, N. Y. Subsidiary of the American Bosch Corporation.

ARMA ADVANCED ELECTRONICS FOR CONTROL

ENGINEERS—write or visit Arma for complete information on challenging opportunities in our engineering division.